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Papers from the proceedings are: "Cultural Universals in the Acquisition of Language;" "The Acquisition of Locative Constructions in Cantonese Children"; "The Acquisition of VOT: Is It Language-Dependent?"; "Flexibility in Semantic Representations: Children's Ability To Switch among Different Interpretations of 'Big' and 'Little'"; "Multifunctional 'Se': Course of Development in Spanish Children"; "Performance Constraints in Early Language: The Case of Subjectless Sentences"; "Object Affectedness and the Acquisition of Novel Verbs"; "Acquiring Proper Names for Familiar and Unfamiliar Animate Objects: Evidence from Two-Year-Olds"; "Early Relations Between Mother Talk and Language Development: Masked and Unmasked"; "Implementations Are Not Conceptualizations: Revising the Verb Learning Model"; "The Acquisition of V Movement"; "Semantic Inferences: The Role of Count/Mass Syntax"; "Distributional Analyses of Parent-Child Conversational Interaction"; "What's Missing in Dutch?"; "Do Young Children Linguistically Encode the Notion of Agent?"; "Crosslinguistic Evidence for the Structure of the Agent Prototype"; "Bootstrapping from Agency: Early Notions of Agency According to Pinker's Semantic Bootstrapping Hypothesis"; and "Semantic Roles and Grammatical Relations." (MSE)

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Editors' Note

This issue of *Papers & Reports on Child Language Development* contains the proceedings of the Twenty-second Annual Child Language Research Forum, held at Stanford, April 6-8, 1990. This year, we have also included the presentations from the special interest group on "Early Notions of Agency." We thank all the members of the CLRF committee whose hard work made the Forum possible; Elinor Ochs (University of Southern California) for giving the Keynote Address; Nancy Budwig, Brian MacWhinney, and Virginia Valian for organizing and leading Special Interest Groups; and all the participants who contributed so much to making the meeting a success.

Next year's Forum, on **April 5-7, 1991**, will be coordinated by Patrick O'Neill and Trisha Svaib. The Keynote Speaker will be **Peter Jusczyk** of the State University of New York at Buffalo. Abstracts (limit 250 words) will be due on January 10, 1990. Abstracts and enquiries should be addressed to Coordinators/CLRF-91, Department of Linguistics, Stanford University, Stanford, CA 94305.

July 1990

Eve V. Clark
Miriam Butt
Tracy King

Previous issues of PRCLD: Articles from previous issues of *Papers and Reports on Child Language Development* are generally available through the ERIC Document Reproduction Service, 3900 Wheeler Avenue, Alexandria, Virginia 22304, U.S.A. (Many articles that appeared in preliminary form in PRCLD have since been published in professional journals in the field.)

PRCLD 29 (1990)

CULTURAL UNIVERSALS IN THE ACQUISITION OF LANGUAGE

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University of Southern California

I. INTRODUCTION

The ideas I am about to put forward are highly speculative in nature. From the point of view of many ethnographers, the discussion borders on the heretical, for what I am considering is the issue of cultural universals in the use of language and their implications for the acquisition of language. Cultural universals? Isn't that an oxymoron? We can consider culture as a set of socially recognized and organized practices and theories for acting, feeling and knowing along with their material and institutional products, associated with membership in a social group. Isn't culture then local, particular, unique? Yes. It is. But culture is also a universal property of the human condition and in this sense, we might expect that aspects of culture, including certain uses of language, will define membership not only in a local group but in the human species as well.

Culture is both particular and universal and any one practice or theory can be examined from either perspective. What I propose to do here is to outline a model for considering universal and particular ways in which language structures culture. While grounded in research in pragmatics and language socialization, the model is speculative and should be taken not as a state of the art report of research but rather as an agenda for future research.

In this discussion, I will necessarily have to limit the

analysis of the relation of language to culture. My focus of attention will be on how language relates to the following four dimensions of culture: 1. epistemic and affective stances, 2) social acts, 3) social activities and 4) social identities. These dimensions are preliminarily defined in the following manner:

1. Stance: a socially recognized disposition
    - 1.a. epistemic stance: a socially recognized way of knowing a proposition, such as direct (experiential) and indirect (e.g. second hand) knowledge, degrees of certainty and specificity.
    - 1.b. affective stance: a socially recognized feeling, attitude, mood or degree of emotional intensity.
2. Social act: a socially recognized performance or doing of an action
3. Social activity: a sequence of two or more social acts that are socially recognized as a unit
4. Social identity: a socially recognized status or relationship (e.g. expert, speaker, strangers)

The model that I propose assumes that language plays an important role in defining each of these cultural dimensions. Following the work of John Gumperz (1982a), the model assumes that communities develop linguistic conventions for marking these dimensions and that when interlocutors interact with one another, they use these conventions to signal one or another stance, act, activity, and identity. These conventions are sometimes referred

to as 'indexes' (Lyons 1977) in that they signal or imply that some stance, act, activity or identity is present or in play in the communicative context. For example, the use of a tag question (as in 'It's raining, isn't it?') may index that the social act we call a request for confirmation is in play (Ochs 1988). In some communities, the use of respect vocabularies may index a deferential stance towards a referent or addressee.

Every child who acquires language acquires a tacit knowledge of the indexical scope of particular linguistic structures. Such knowledge is critical to assigning meaning to linguistic constructions (hence indexical competence is part of linguistic competence) and to functioning as a member of a particular social group (hence indexical competence is part of cultural competence). I am interested in the nature of indexicality, here in particular, in the extent to which children in different social groups may be acquiring and relying upon similar structures to index cultural information.

II. THREE HYPOTHESES

The core of the proposed model consists of three hypotheses increasing in specificity from the first to the last. The hypotheses suggest how we might talk about language and culture universals and particulars. That is, the model suggests a set of generalizations to be examined and refined through future ethnographically astute studies of speaking and thinking and feeling among children and adults across the world's societies. As in other research on language, these hypotheses propose non-

absolutive universals, that is, widespread practices and tendencies rather than language use patterns found in all societies (Comrie 1981).

A. HYPOTHESIS ONE : THERE ARE CULTURALLY UNIVERSAL TENDENCIES IN THE LINGUISTIC MARKING OF STANCE, SOCIAL ACTS, SOCIAL ACTIVITIES AND SOCIAL IDENTITIES.

This first hypothesis makes a simple claim that if we look at stance, acts, activities and identities, we will find that certain linguistic structures are used across a wide number of communities to index certain of the same stance, act, activity and identity meanings. Let us consider this claim for each of these four cultural domains.

Stance:If we examine how language indexes stance, we can find candidate universals in the indexing of both epistemic and affective stance. In the domain of epistemic stance, for example, indirect knowledge is widely indexed through reported speech predicates (e.g.'says' 'reports'); uncertain knowledge is indexed in many societies through modals (e.g. 'can','could', 'may', 'might'), rising intonation (e.g. 'You're going out?'), and/or interrogative structures ('Where are you going?'). As eloquently summarized by Levinson (1983), certain knowledge is widely indexed through factive predicates (e.g.'know', 'realize', 'be aware of'), determiners (e.g.'the'), cleft constructions (e.g. 'It wasn't a book that I read', 'What I read wasn't a book'), and iteratives (e.g. 'He left again' 'He didn't leave anymore') among other structures.

In the domain of affective stance, in many communities, increased affective intensity is indexed by switching to a form not typically used in referring or addressing a person (Ochs & Schieffelin 1989), e.g. using plural marking for a single referent, using a demonstrative pronoun in place of a personal pronoun (in Italian 'quello' instead of 'lui'). Intensity is also indexed through vowel lengthening ('It was stu::pendous'), through modulating loudness up or down (as in shouting or whispering) and modulating speed of delivery. As noted in Brown and Levinson in their study of politeness universals (1987), positive affect is widely indexed through in-group address forms (e.g. 'mate' 'brother') and switching to a local dialect or language. Also widespread is the indexing of positive affect through diminutive forms (e.g. in Italian 'uccell-ino' means '(sweet) little bird',when contrasted with 'uccell-accio' 'nasty big bird' in Pasolini's reknowned film Uccellaci e Uccellini (translated into English as The Hawks and Sparrows.

Social act: In the domain of social acts, requests for information are indexed through interrogative pronouns and syntax and through rising intonation in many communities; and requests for confirmation through tag questions ('We're going, aren't we?') or tag particles such as 'huh' in English, 'a' in Samoan , and 'ne' in Japanese. Interrogative structures are also widely used to index requests for goods and services (e.g. 'Could you give me a ride home?") as are predicates with verbs of need ("I need a ride home") and desire ("I want a ride home") (Gordon & Lakoff 1971).

In many societies, address terms and imperatives index directives such as summons (e.g. 'Lady!) and orders (e.g.'Turn left!'). Further, probably all societies have available affirmative and negative forms to index the acts of agreement and disagreement.

Social activity: In the domain of social activities, we can isolate two levels of candidate universals in the linguistic structuring of social activities. On one level, we may find

THERE ARE UNIVERSAL TENDENCIES IN THE KINDS OF SPEECH ACTS OR STANCES THAT CONSTITUTE A PARTICULAR TYPE OF SOCIAL ACTIVITY

This generalization proposes that across a wide range of societies certain activities are constituted by similar social acts or stances. That is, certain activities may entail certain social acts or certain stances. Candidate universals in this sense include disputes (which may include at least one disagreement and/or negative affect), clarification (which may include at least either a request to restate a proposition or a statement of noncomprehension, or a request to confirm a guess plus uncertain stance) and planning (which may include at least a method for responding to some identified problem.) This universal concerns only act and stance to activity relations and speaks to linguistic structuring only on this level of discourse.

A second level of universality takes the following form: We will find

THERE ARE UNIVERSALS IN THE GRAMMATICAL, LEXICAL AND PHONOLOGICAL INDEXING OF SOCIAL ACTIVITIES TO THE EXTENT THAT 1) ACTIVITIES ARE COMPOSED OF SIMILAR SOCIAL ACTS AND STANCES AND 2) THESE SOCIAL ACTS AND STANCES ARE INDEXED THROUGH THE SAME GRAMMATICAL, LEXICAL AND PHONOLOGICAL FORMS.

This generalization rests on the notion of associative or indirect indexicality (Ochs 1988), which claims that grammatical, lexical and phonological forms may index a range of cultural meanings that are associated with one another. In this case, linguistic forms may index not only stance or not only social action but the set of social activities associated with the display of some stance or social act. In other words, a social activity that is constituted through some stance or some social act may be indexed through the same linguistic forms that index that stance or social act. Hence an activity such as a funeral may be indexed through the same linguistic forms that index the affect of grief if funerals are culturally constituted through or associated with the display of grief. Members of a society rely on these linguistic forms to recognize not only what stance is being displayed but what activity is taking place as well.

In the current discussion, we are concerned with universals in the grammatical, lexical and phonological indexing of social activity. I have proposed that there are universals to the extent that there are universals in the stance and act constitution of specific activities and that there are universal patterns in the linguistic marking of those constitutive stances and acts. Let us consider a candidate universal. We have noted that in many societies, dispute activities entail acts of disagreement and a stance of negative affect. In addition, disagreements and negative affect are indexed through similar linguistic forms across societies (e.g negative particles, modulation of volume or pace of

speech). To the extent these forms do index disagreement and negative affect across societies and to the extent that disagreements and negative affect constitute the activity of disputes across societies, we expect to find universals in the grammatical, lexical and phonological indexing of disputes.

Social identity: As in the domain of social activities, social identities are in part constituted through social acts and stances. I propose that, like social activities,

THERE ARE UNIVERSAL TENDENCIES IN THE KINDS OF SOCIAL ACTS OR STANCES THAT CONSTITUTE A PARTICULAR TYPE OF SOCIAL IDENTITY.

For example, it is probably a universal that higher ranking persons receive from lower ranking persons a stance of deference. Higher rank is also widely indexed through rights to directive acts such as orders and summons.

Again as in the domain of social activities, we expect to find universals in the grammatical, lexical, and prosodic indexing of social identities to the extent that the stances and social acts that universally constitute particular identities are themselves indexed through similar grammatical, lexical or phonological forms:

THERE ARE UNIVERSALS IN THE GRAMMATICAL, LEXICAL AND PHONOLOGICAL INDEXING OF SOCIAL IDENTITIES TO THE EXTENT THAT 1) IDENTITIES ARE COMPOSED OF SIMILAR SOCIAL ACTS AND STANCES AND 2) THESE SOCIAL ACTS AND STANCES ARE INDEXED THROUGH THE SAME GRAMMATICAL, LEXICAL AND PHONOLOGICAL FORMS.

I suggest that this condition holds for the indexing of higher rank. We have noted that higher rank entails receiving deference from others in many societies in the world. As noted by Brown and Levinson (1987), it is also the case that deference is indexed in

similar ways across societies, for example, through respect vocabularies (e.g. use of 'dining' 'residence' 'care to' in English) or honorific marking in many societies, through indirect forms of speech acts, and through hedges (e.g. 'sort of' 'kind of' 'rather''in a sense') Another potential language and culture universal is the marking of expert status. In numerous social groups, expert status may be indexed linguistically through use of a specialized lexicon, through highly detailed descriptions and linguistic markers of certainty in speaking to novices.

These suggested universal tendencies in the indexing of stance, social acts, social activities and social identities mean that members of cultures the world over may be socializing their children through language in similar ways. Children may well be acquiring common linguistic strategies for structuring social life regardless of the society in which they seek membership. These similarities are what makes it possible for people from one society to communicate at all with other societies. For better or for worse, these proposed commonalities may allow for interactional co-ordination across social boundaries. Although we know that miscommunication is rampant in such interactions, it is nonetheless the case that some aspects of stance, social action, social activity and social identity are grasped, that some cultural meanings travel across the borders of particular communities. Ethnographers, immigrants, travelers all - rely upon these common indexical threads as they strive to make sense out of and participate in social life. Culture shock and crosstalk are

outcomes of their inability to go beyond these shared meanings to understand other, local meanings indexed by particular linguistic structures.

B. HYPOTHESIS TWO: LANGUAGE AND CULTURE UNIVERSALS LIE PRIMARILY IN THE INDEXING OF STANCE AND SOCIAL ACTS. THE LINGUISTIC MARKING OF STANCE AND SOCIAL ACTS IS MORE WIDESPREAD AND MORE CONVENTIONALIZED ACROSS SOCIAL GROUPS THAN THE MARKING OF OTHER DOMAINS.

This hypothesis takes a stronger stand and proposes that it is easier to find candidate language and culture universals in the indexing of stance and social acts than in the indexing of social activities and social identities. A partial reason for why we might find more examples of non-absolutive universals here is that these domains are richly indexed in the grammar, lexicon, and phonology of all languages, as two decades of research on pragmatics attest.

But we still are faced with the question of why social groups develop such rich indexical systems for marking stance and social action in the first place. I suggest that stance and social action are privileged in part because they are the basic building blocks of cultural entities such as social identities and social activities. Stance and social action help to define a particular status, a particular relationship, a particular activity. If you want to understand who you are, who the people around you are, what their relationship is to one another and to you, and what kind of activity you are participating in, then you need to recognize the stances and social acts being displayed. Stance and social action

markings thus provide valuable keys to understanding what is happenning at any one moment in time. And this understanding in turn is critical to species survival in the long run and to making the appropriate next move in the short run. As Gregory Bateson notes in Steps to an Ecology of Mind (1972) and in Mind and Nature (1979), stance and social action are richly and conventionally indexed not only for humans but in the behavior of other animals as well. Knowledge and recognition of stance and action framing conventions are crucial to evaluating the seriousness of the situation at hand. Bateson's famous example is 'The playful nip is not the bite', meaning that an animal's survival may rest on the ability to distinguish between the indexes of play and serious acts. Continuity of social life, indeed communication of the most fundamental sort, thus depends on members' recognition of stance and social act indexes. In many ways, knowledge of the structures that index types of stance and social action is what allows humans and other species to co-ordinate their behaviors, to co-operate or otherwise engage in what Vygotsky (1978) calls 'joint activity'. While not many of these indexes are shared across species, within the human species certain stance and action indexes do cut across social boundaries and to the extent that this is the case, such universal markings further promote human continuity and human co-operation.

C. HYPOTHESIS THREE: (HYPOTHESIS TWO ASSUMED +) LANGUAGE AND CULTURE PARTICULARS LIE PRIMARILY IN HOW STANCE AND SOCIAL ACTS RELATE TO SOCIAL ACTIVITIES AND SOCIAL IDENTITIES ON THE OTHER.

This proposal suggests another reason why there may be more language and culture universals on the level of stance and social act marking than on the level of social activity and social identity marking. It suggests that while there are certain universal patterns in the stance and act make up of activities and identities, there are many cultural differences. Among other considerations, cultural differences concern

1) the **range** of stances and social acts appropriate to particular activities and particular social identities,

2) the **frequency** of stance and act displays appropriate to a particular activity and social identity.

Let us consider first the range of stances and social acts appropriate to activities and identities. Consider, for example, the social identity of chief in traditional communities in Western Samoa. While chief may entail certain of the same stances and social acts of high status persons across societies,(e.g. receiving deference, and rights to directive social acts), there will be other stances and social acts that index Samoan chiefs uniquely, particularly. For example, in decision-making activities, chiefs have the right and are expected to express opinions to lower status persons whereas lower status persons are expected to make suggestions when invited to do so (Duranti 1981, in press). For members of the Samoan community, then, chief entails the right to give opinions. Another way of putting this is to say that in this community, the social act of giving an opinion indexes the status

of chief. However, the same social act does not necessarily translate as an index of chief (or necessarily of high status more generally) in other societies. This indexical meaning is a culture-particular meaning that Samoan children must acquire but not, for example, children growing up in mainstream middle class households. in the United States.

Turning to frequency of stance and act displays, Bambi Schieffelin and I have suggested (Schieffelin & Ochs 1988) that societies differ in how often a particular stance or social act is appropriately displayed by a particular social identity in the course of a particular activity. For example, while the social activity of prompting a child is probably universal, societies differ in the typical number of individual prompts that occur within this activity. In Melanesian societies like the Kwara'ae (Solomon Islands) and the Kaluli (Papua New Guinea), for example, prompting activities typically involve far more prompting acts than in other societies (Watson-Gegeo & Gegeo 1986, Schieffelin 1979, in press). When transcribed, these activities often take up several pages of transcript, whereas prompts recorded in other communities are of far shorter duration.

Another example of cultural differences in frequency of social acts concerns the activity of clarifying an unintelligible utterance. As noted earlier, clarifying universally entails very similar alternative social acts. Probably universally clarification is carried out either by indicating one has not understood or by requesting a reformulation or restatement of all or part of the

unintelligible utterance or by requesting a confirmation or disconfirmation of a verbalized guess at what the utterance might be. However, cultural particulars lie in the frequency with which these alternative acts are displayed in the activity of clarifying. In traditional Samoan communities, for example, requests to confirm or disconfirm a verbalized guess are quite rare, whereas for Euro-American societies, such requests are commonplace (Ochs 1988).

These cross-cultural differences in range and frequency of stances and social acts appropriate to particular social activities and social identities are vital to both acquirers and researchers in that they are windows to local theories of thinking, feeling and acting, to values, and to larger political and economonic institutions. For example, the range of stances and social acts associated with male and female speakers provides valuable information concerning the politics of gender. The frequency of prompting acts in a society provides valuable information concerning local theories of instruction. The high or low frequency of verbally guessing at an unintelligible utterance implies a world view as to how clarification, indeed communication as a whole, is to be accomplished.

As the work of John Gumperz and his collegues eloquently displays (Gumperz 1982a, 1982b), it is this area of knowledge - knowledge of the stance and act entailments of activities and identities - that seems so elusive to those acquiring second cultures and second languages in adult life. The major problem in cross-cultural communication is not that interlocutors do not

understand one another at all. I would venture to say that interlocutors understand quite a lot of the stance and social act meanings indexed in one another's utterances. Communicative expectations break down largely because from the perspective of one or the other interlocutor, the stance and act display was not expected or appropriate or went on too long for the particular activity underway or the particular social status or social relationship assumed to be in play. The problem is that some cultural understanding is shared but not all. When this occurs, each interlocutor is jarred and may consider the other to be rude or incompetent.

III. ACQUIRING LANGUAGE-AND-CULTURAL COMPETENCE

Whether we are speaking of first or second language acquisition, and whether we are speaking of language and culture universals or particulars, language-and-cultural competence rests on the ability to use language constitutively. Acquirers must learn to use and recognize linguistic indexes of stances and social acts and they must learn how stances and social acts constitute social activities and social identities and other facets of what some scholars call 'culture' and others call 'context'. Only through knowledge of how language relates to each of these domains can an acquirer recognize the indexical scope of language and participate as a member of society.

In terms of first and second language acquisition there is much to be done. An urgent agenda is to sort out more precisely how

acquirers do develop competence in indexing and linguistically constituting social life. What do acquirers at different points in time know about the indexing of stance, social action, social activities and social identities? Where do the bulk of their errors fall? In the indexing of stance and social action? Or in the co-ordination between stance and social action on the one hand and activity and identity on the other?

The notion of culture has become quite fashionable in psychology in these post-modern times. It has surfaced in the enormous popularity of Vygotsky, Luria, Leontyev and other proponents of socio-historical psychology, in the renewal of cultural psychology as represented by the recent volume of that name edited by Stigler, Shweder and Herdt (1990), in the rediscovery of Gibson's ecological theory of visual perception (Gipson 1979), in the rise of context-centered approaches such as parallel-distributed processing (Rumelhart et al 1986), in the impact of socialization research on the field of human development, (Cicourel 1973, Goodnow 1990), in a general awareness that thinking and feeling are situated in a culturally constituted life space, and in the willingness of major funding bodies such as the National Institute of Health and the Social Science Research Council to establish working groups and otherwise nurture the pursuit of a culturally attuned psychology.

We may safely say that culture is 'in'. At the same time the future of culture as an object of study within psychology is somewhat clouded by the way it has been considered. Culture tends

to be reified and glorified as terribly important but obscure and hard to get a handle on. You can't see it; you can't count it; where is it? This almost religious view of culture is highly distancing. Culture, like God, becomes almost unknowable. Such a perspective discourages the learning and incorporation of specific ethnographic skills within psychology. And yet such skills are critical to describing specific situations and meanings and accounting for processing and production strategies of adults and children alike. For all the many mentions of context, situatedness, and culture, few culturally keen psychological studies attend with rigor to norms, preferences, and expectations surrounding the expression of stance, the performance of social acts, and their changing and unchanging relation to the constitution of social, economic and political identities and activities. Without this knowledge, we are doomed to view culture only as an environment (as captured in the notion of 'situatedness' as in 'situated knowledge') or only as a constraint on mental activity (as captured in the notion of culture as an independent variable). We will never make progress in understanding the kinds of psychological skills that are demanded of particular social activities or particular social roles in activities; or the ways in which cultural knowledge is acquired. We will not get a whit closer to substantiating or furthering in any interesting way the notion put forward originally by Vygotsky and rearticulated by Cole (Cole 1985) that culture and cognition create each other in the course of social interaction. An adequate theory of cultural psychology

demands adequacy at the level of culture as well as psychology, as Sapir noted years ago. It is not enough to an aficionado of culture, an enthusiast of culture. It is time, indeed it is past time, for the cultural psychologist to become a serious student of culture.

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The Acquisition of Locative Constructions in Cantonese Children

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1 The Static Location, the Locative Source and the Locative Goal

This paper reports on the first systematic study of how Cantonese children acquire the locative system in their first language. The locative system in Cantonese is very complex. Three semantic categories turn out to be most important in the language. They are the static location, the locative source and the locative goal. The static location (LOC_{at}) is defined as the location at which a state or an event takes place, e.g., "He's walking around in the library" and "It's jumping up and down on the bed." The locative source (LOC_{from}) is the starting point of a moving entity whereas the locative goal (LOC_{to}) is the end-point of a moving entity, e.g., "It's jumping off the chair" and "It's jumping onto the table" respectively. Examples in Cantonese are shown in (1) and (2) below.

(1) *wou-wou* ***hei*** ***zêng-toi*** ***guo-dou*** *tiu*
dog LocCvb CL-table there jump
"The dog is jumping (up and down) on the table."

(2) *wou-wou* ***hei*** ***zêng-yi*** ***guo-dou*** *tiu-sêng* ***zêng-toi*** ***guo-dou***
dog LocCvb CL-chair there jump-up CL-table there
"The dog is jumping from the chair onto the table."

In (1), the ***hei zêng-toi guo-dou*** meaning "on the table" occurs before the main verb *tiu* "jump" and is a LOC_{at}. In (2), ***hei zêng-yi guo-dou*** and ***zêng-toi guo-dou*** are a LOC_{from} and a LOC_{to} respectively.

In English all three locative phrase types usually follow the main verb, and are distinguished mainly by prepositions. In Cantonese, these categories are differentiated in a number of ways, one of the major ones being word order. As illustrated in (1) and (2) above, LOC_{at} and LOC_{from} precede the main verb, but LOC_{to} follow the main verb. However word order does not suffice to distinguish LOC_{at} from LOC_{from} since both occur preverbally. The verb gives additional clues: the main verb tends to be followed by directional verbs such as "go", "come", "up" and "down" in the case of LOC_{from}.

2 Subjects

Thirty-two monolingual Cantonese children aged 2;5 to 5;9 in Hong Kong were tested. The children formed four groups: (1) 2;1 to 2;5 (mean age: 2;3); (2) 3;0 to 3;5 (mean age: 3;3); (3) 4;1 to 4;9 (mean age: 4;3); (4) 5;0 to 5;9 (mean age: 5;4). There were four boys and four girls in each group. They all spoke Cantonese as their first language. Data were also collected from eight adult Cantonese speakers.

3 Tasks

Each subject was asked to perform four tasks, two of them designed to test their comprehension of the three locative constructions and the other two designed to elicit

production data for these three constructions. The order of the tasks was randomized for each subject. The four tasks were completed in four to six interviews with the two-year-olds and in two to three interviews with the older children.

3.1 Comprehension Tasks

3.1.1 Experimental Design

The two comprehension tasks were two-factor experiments with repeated measurements. The two independent variables are age and position of LOC. The age factor had five levels: two-, three-, four-, and five-year-olds, and adults. The position factor had two levels - preverbal and postverbal. In one task, the preverbal LOC was LOC_{at} and the postverbal LOC was LOC_{to}. In the other task, the preverbal LOC was LOC_{from} and the postverbal LOC was LOC_{to}. The dependent variable was the subjects' response to the test items with each correct response being given a score of one point.

3.1.2 Test Items

Motion verbs such as "jump" and "fly" and displacement verbs such as "spill" and "push" were used in these tasks. The advantage of using these kinds of verbs, as opposed to verbs like "sing" and "study", is that they can take both preverbal and postverbal LOC's, the meanings of these verbs depending to a large extent on the position of the LOC with respect to the main verb. The test items for the task that tested LOC_{at} and LOC_{to} were ten real Cantonese words and two non-words. The real Cantonese words were "crawl", "jump", "fly", "walk", "push", "carry", "toss", "hit", "swim", and "spill". Each of the twelve words was presented twice, once with a preverbal LOC and once with a postverbal LOC. A pair of such sentences is given in (3). There were a total of twenty-four test sentences. The order of presentation of the sentences was randomized for each subject.

(3) (a) *wou-wou* ***hei*** ***zêng-toi-toi*** ***guo-dou*** *tiu*
dog LocCvb CL-table there jump
"The dog is jumping on the table."

(b) *wou-wou* *tiu-sêng* ***zêng-toi-toi*** ***guo-dou***
dog jump-up CL-table there
"The dog jumped onto the table."

The test items for the task testing LOC_{from} and LOC_{to} were three real Cantonese words, *tiu* "jump", *fei* "fly", and *pa* "crawl", and the two non-words. Examples of test sentences for this task are given in (4).

(4) (a) *wou-wou* ***hei*** ***zêng-toi-toi*** ***guo-dou*** *tiu-log-lei*
dog LocCvb CL-table there jump-down
"The dog is jumping down from the table."

(b) *wou-wou* *tiu-log* ***zêng-toi-toi*** ***guo-dou***
dog jump-down CL-table there
"The dog is jumping down onto the table."

3.1.3 Procedure

The children were first shown the props which consisted of human figures, toy animals and furniture. The younger children were asked to label the props to make sure that they knew the labels. In some cases the children's labels were used in this task. The subjects were asked to act out the experimenter's instructions. Two warm-up items with the verbs "push" and "climb" were given.

3.1.4 Results

Figures 1 and 2 show the means for correct responses in each age group.

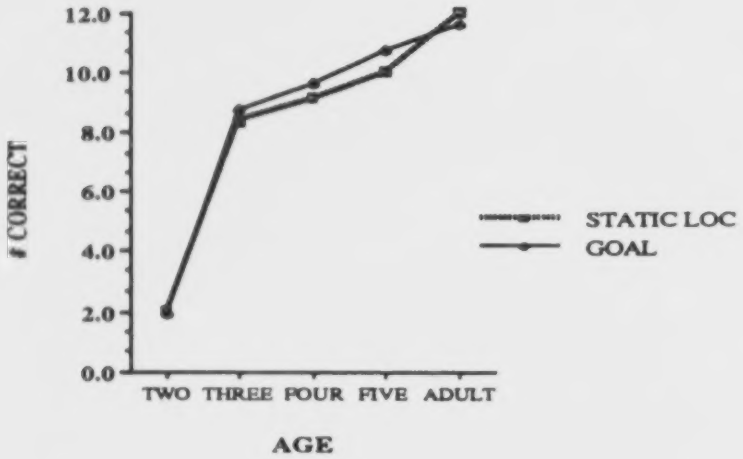

Figure 1: Comprehension of Static Location and Locative Goal.

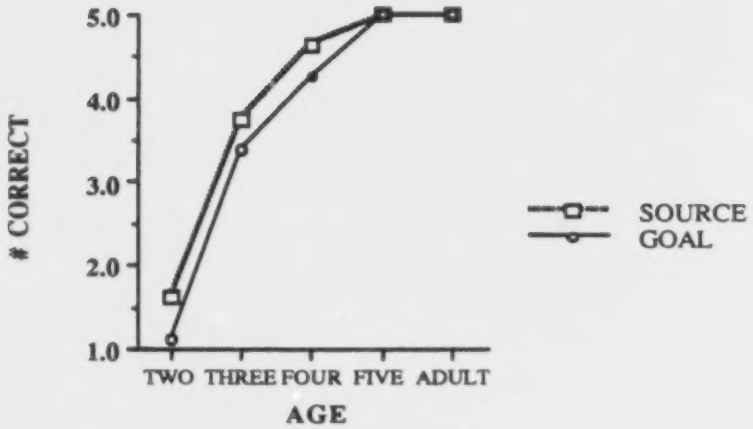

Figure 2: Comprehension of Locative Source and Goal.

The two-year-olds did poorly in both comprehension tasks, as shown by the low means. The older children did a lot better than the two-year-olds. ANOVA's for two-factor experiments with repeated measurements were performed on the comprehension data. In both tasks, the age effect was highly significant ($F=68.97$ and 39.46; $p<.001$). Adjacent age groups were contrasted. The results were as follows: (a) the three-year-olds did significantly better than the two-year-olds in both tasks ($t=13.64$ and 6.11; $p<.001$); (b) the four-year-olds outperformed the three-year-olds in both tasks ($t=1.67$ and $p<.05$ for the task contrasting LOC_{at} and LOC_{to}; $t=2.44$ and $p<.01$ for the task contrasting LOC_{from} and LOC_{to}); (c) the difference between the four- and five-year-olds was significant only in the task contrasting LOC_{at} and LOC_{to} ($t=2.05$; $p<.05$); (d) the adults did significantly better than the five-year-olds in the task contrasting LOC_{at} and LOC_{to} ($t=2.96$; $p<.001$). The position of LOC effect was not statistically significant, and there was no significant interaction between age and position.

3.2 Production Tasks

These tasks elicited production data from the children using the same test items as the two comprehension tasks. Instead of asking the children to act out the experimenter's instruction, they were asked to describe to a blindfolded puppet what the experimenter was doing. The experimenter acted out the sequences described in the test sentences used in the comprehension tasks; each sentence was acted out twice. On the first occasion the experimenter asked the child to watch what she was doing. Then, when she repeated the action sequence, she said to the child, "Tell me what the doggie is doing." Small children very often did not provide her with a locative phrase. When that happened, she tried to elicit the locative phrase by asking "where"questions.

3.2.1 Results

Table 1 shows the proportions of utterances containing a main verb and a locative phrase in the children's spontaneous responses to the instruction "tell me what X is doing" in both production tasks. Sometimes the subjects produced more than one token of LOC to an instruction and all their tokens are included here.

AGE \ POSITION	PREVERBAL	POSTVERBAL
TWO	.03	.97
THREE	.20	.80
FOUR	.52	.48
FIVE	.40	.60
ADULT	.50	.50

Table 1: Proportions of Utterances Containing a Verb and a Preverbal or Postverbal LOC Elicited by "Tell Me What X is Doing."

Almost all the tokens from two-year-olds were postverbal. They came mainly from four children. The main reason was that the two-year-olds did not use word order to differentiate the three kinds of LOC's. When the contexts in which the postverbal LOC's occurred were examined, it was found that some of these LOC's in context referred to LOC_{to}'s, some to LOC_{from}'s and some to LOC_{at}'s. Examples from one of the two-year-olds (Luke) are given in (5):

(5) Luke, 2;1, Male

(a) Task 4, Item 1: "The dog is jumping down from the chair."
pa ***deng-deng*** *a*
crawl chair Prt

(b) Task 2, Item 2: "The baby is crawling (around) on the bed."
pa ***cong-dan*** *a*
crawl sheet Prt

(c) Task 4, Item 4: "The bird is flying down onto the car."
fei ***dai-che*** *a*
fly big car Prt

LOC_{from}, LOC_{at} and LOC_{to} were tested in (5)(a), (5)(b) and (5)(c) respectively, and Luke produced postverbal LOC's in all three cases.

Only two tokens of preverbal LOC's were elicited from the two-year-olds by the instruction "Tell me what X is doing". The two tokens came from two two-year-olds. One token was a LOC_{from} and the other was a LOC_{at}. These two children produced many more postverbal LOC's which, in context, were LOC_{from}'s and LOC_{at}'s. So it is unclear how much weight should be given to these two instances of preverbal LOC's.

The three-year-olds also produced many more postverbal LOC's than preverbal ones. Some of them also made word order errors, but not as frequently as the two-year-olds. There was a considerable amount of variability among the three-year-olds. The more advanced three-year-olds were able to use word order to contrast the three kinds of LOC's, but the less advanced ones were not able to do so. The least advanced three-year-olds made word order errors like a two-year-old child, as shown in (6), where (6)(b) and (6)(c) have the wrong word order:

(6) Mike, 3;0, Male

(a) Task 2, Item 1: "The baby is crawling onto the bed."
pa ***cong***
crawl bed

(b) Task 2, Item 2: "The baby is crawling (around) on the bed."
pa ***cong***
crawl bed

(c) Task 4, Item 12: "The baby is crawling down from the bed."
pa ***cong***
crawl bed

In all three cases, Mike produced a postverbal LOC regardless of whether the experimenter was acting out a LOC_{to}, LOC_{at} or LOC_{from}. In fact, all the locatives this child produced in response to the instruction "Tell me what X is doing" were postverbal. Though he was not using word order to contrast the three LOC types in production, he was using it in comprehension to differentiate the three LOC types. He was correct 79% of the time on the two comprehension tests. He was wrong on only 7 out of the total 34 tokens. Of his 7 errors, 3 of them concerned the LOC_{at}, 3 involved the LOC_{to} and 1 concerned the LOC_{from}. His comprehension was definitely ahead of his production, and this was quite typical of the less advanced three-year-olds.

The four- and five-year-olds produced both preverbal and postverbal LOC's. Most of the LOC's produced by four- and five-year-olds were correct by adult standards; that is, the preverbal LOC's were either LOC_{at}'s or LOC_{from}'s and the postverbal ones were LOC_{to}'s.

Recall that the experimenter asked follow-up "where" questions if the children did not give a LOC in response to the instruction "tell me what X is doing". This was quite often done with the two-year-olds and some of the three-year-olds. The less advanced three-year-olds, who could not use word order spontaneously to contrast the three locative constructions in their spontaneous production, often picked up the word order clues in the experimenter's follow-up questions. The most advanced two-year-olds were sometimes able to alternate between the preverbal and postverbal positions when clues were given in the input. The less advanced children only produced postverbal LOC's regardless of the word order in the input. Two two-year-olds, though, did not even understand "where" questions. But they showed evidence in their spontaneous interactions with the experimenter that they could use the simple construction "NP + Question Particle *ne*" to ask the whereabouts of their parents.

Two two-year-old girls' elicited data were unlike those of the rest of the two-year-olds. One consistently produced preverbal LOC's regardless of the word order of the locative phrase in the experimenter's follow-up questions. Two of her typical responses are reported in (7) below.

(7) Joy, 2;4, Female

(a) Task 2, Item 1: "The baby is crawling onto the bed."

Experimenter:	***bi-bi***	***pa-sêng***	***bin-dou***
	Baby	crawl-up	where
Joy:	***ni-dou***	***pa-sêng***	
	here	crawl-up	

(b) Task 2, Item 9: "He is pushing the little brother onto the sofa."

Experimenter:	***kêu***	***own***	***a-dei-dei***	***log***	***bin-dou***	***a***
	he	push	little-brother	down	where	QuesPrt
Joy:	***ni-dou***	***da-da***	***dei***			
	here	hit-hit	little-brother			

When locations were explicitly questioned, Joy consistently provided the experimenter

with the missing information first. In spontaneous production, she put a LOC after a main verb all the time.

The other girl, Sue, seemed to be contrasting the three kinds of LOC's in some way. She responded with "LOC + Verb" half of the time when the question was about LOC_{from} and LOC_{at}. When LOC_{to} was questioned, though, most of time she responded with a locative pronoun and pointed at the object affected. Examples are given in (8).

(8) Sue, 2;2, Female

(a) Task 2, Item 1: "The baby is crawling onto the bed."

Experimenter: *bi-bi* *pa-sêng-hêu* ***bin-dou*** *a*
Baby crawl-up-go where QuesPrt

Sue: ***ni-dou*** (Pointing at the bed.)
here

(b) Task 2, Item 2: "The baby is crawling (around) on the bed."

Experimenter: *bi-bi* *hei* ***bin-dou*** *pa-pa* *a*
Baby LocCvb where crawl-crawl QuesPrt

Sue: ***ni-dou*** *pa-pa*
here crawl-crawl

4 Discussion

The study reported here focuses on the acquisition of word order in the Cantonese locative system. Two-year-olds did not use word order to differentiate the three types of LOC's in comprehension. Older children could use word order to contrast the three kinds of LOC's. The errors that older children made tended to be with test sentences that contained transitive verbs such as "push" and "throw". For example, one set of sentences tested the contrast between "the boy is throwing a pillow onto the sofa" and "the boy is throwing a pillow on the sofa." The latter sentence is ambiguous in English but it is not so in Cantonese. "On the sofa" is preverbal in Cantonese, and the only adult interpretation possible is "the boy is throwing a pillow and he's doing so on the sofa." Almost half of the older children did not interpret this distinction correctly. Instead, they tended to make the boy throw the pillow *onto* the sofa. As for the two-year-olds, they all missed this item. Their error was quite different: they tended to put the pillow on the sofa and then put the boy on the sofa, pretending that the boy was sleeping there. Other errors made by the older children were with less common directional words, e.g., *mai* "close/toward". One test sentence asked the children to make a dog swim closer and closer to a bowl. Half of the older children made the dog swim into the bowl. None of the adults tested made this mistake.

It was expected that transitive verbs would be harder for the children than intransitives, and they were. Children had to keep track of two entities (an agent and a patient) simultaneously in the case of transitive verbs whereas they only had to deal with one entity in the case of intransitives. Moreover, one class of verbs very similar to verbs of displacement can take both preverbal and postverbal LOC's without affecting the meaning of the sentence in a major way. These are verbs of placement such as "put" and "plant". When these verbs are involved, the position of the LOC is determined primarily by discourse factors. Moreover, the position of the LOC in a sentence does not affect the

end-state of the object being placed. For example, *the book* in the Cantonese preverbal version "he on the table put a book" and *the book* in the Cantonese postverbal version "he put a book on the table" both end up being placed on the table. Since verbs of placement are quite like transitive verbs of displacement, it is perhaps not surprising that Cantonese children take a long time to sort out word order contrasts pertinent to transitive verbs of displacement.

Directional verbs turn out to play an important role in Cantonese children's comprehension of spatial relations. One two-year-old child's (Kit) comprehension data were most revealing. Kit seemed to understand all the tokens of LOC_{from} in the task designed to test subjects' comprehension of this type of LOC phrase. This was strange because the two-year-olds in general did very poorly in the task. Close examination of his data revealed that Kit was actually relying on the directional verb *log-lei* "down" in the test sentences. It turned out that the verb in all the sentences testing the LOC_{from} consisted of a motion verb and the directional verb *log-lei* "down". Kit was paying attention to the directional verb and successfully moved an object from a higher location to a lower one. For example, in hearing the instruction "make the bird fly from the car", he made the bird fly from the car, which was a higher location, to the ground, which was a lower location. There was evidence that he was indeed relying on the directional component "down": when his production data were examined, he was found to be producing the directional verb *log-lei* "down" spontaneously. (For a detailed discussion of the acquisition of directional verbs, see Cheung (1990).)

In spontaneous production, two-year-olds did not use word order to contrast the three locative constructions. Almost all of their spontaneous LOC's were postverbal. The overwhelming preference for the postverbal position is very likely due to the influence of the basic word order in Cantonese - Subject-Verb-Object. The two least advanced two-year-olds didn't even understand simple "where" questions. But they both showed evidence that they could use the simple construction "NP + Question Particle *ne*" to ask the whereabouts of their parents, suggesting that they had some notion of "entity being in a place". The three-year-olds showed considerable variability: the more advanced ones could use word order to contrast the three locative constructions, but the less advanced ones could not. The least advanced three-year-olds made word order errors in production like the two-year-olds, but their comprehension was much better than the two-year-olds. When word order clues were provided in the adult input, the less advanced three-year-olds and the more advanced two-year-olds were able to pick up the clues. One two-year-old incorporated gestures when she contrasted the preverbal and postverbal LOC's. Another two-year-old consistently produced preverbal LOC's in response to questions specifically asking about locations. This child was very likely giving new information first. As for the older children, it is very clear that the four- and five-year-olds used the relevant word order contrasts in production.

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THE ACQUISITION OF VOT: Is it language-dependent?

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Introduction

Early theories of phonological acquisition concentrated on the phoneme as a whole. The criterion for determining that a phoneme had been acquired was the attainment of an adult-like production as judged by the listener. While researchers investigating these models did not particularly concern themselves with acoustic measurement, an adult-like production assumes that all the acoustic values associated with the sound in the adult model are present and correct. By definition then, when a phonemic contrast is evidenced, the acoustics have already been learned. There is no way to determine what stages, if any, the child goes through in his attainment of the correct production values. A more revealing approach from this perspective would be to break the phonemes down into their appropriate features and then to investigate the corresponding acoustic cues.

The present study is concerned with the acquisition of the phonemic feature /voice/, which is the distinguishing feature in the initial sounds of the pair, "cap" and "gap", for example. There is a general concensus in the literature that voice onset time, or VOT, (the amount of time, usually measured in milliseconds, between the onset of periodic vocal fold vibration and the release of oral closure), is the most salient perceptual cue to phonemic stop voicing.

The following schematic diagram (figure 1) illustrates how the phonemic systems of the languages to be discussed in this paper employ phonetic categories along the VOT time line.

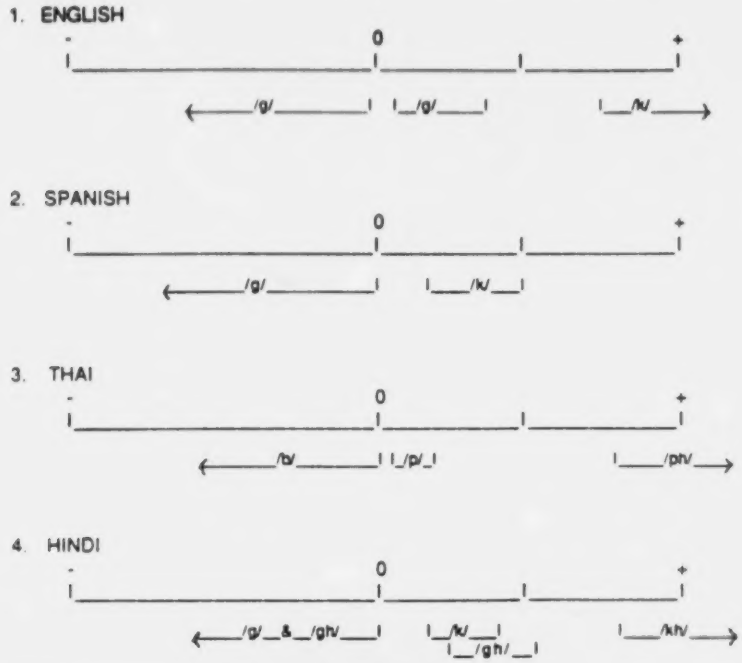

figure 1. Phonemic Systems - initial position (schematic)

Note that in English initial position the voiceless stop phoneme is phonetically realized as a long lag production. The voiced stop is realized with either prevoicing or short lag timing, depending to a large extent on the individual speaker. In Spanish, the voiceless stop has short lag timing, and the voiced stop must be prevoiced. Thai has three contrasting phonemes (except at the velar place), realized as indicated. The Hindi system is rather special in that the voiced aspirated stop has a fair amount of lag time in addition to the required prevoicing. With this background we may move on to the examination of some actual data.

In the mid-seventies, several studies on the acquisition of English voice onset time, (or VOT), were carried out, among them, Macken and Barton (1977), Zlatin and Koenigsnecht (1976), and Kewley-Port and Preston (1974). In spite of the fact that some of the studies were longitudinal and some were synchronic, they all agreed that in the very early stages of acquisition there seemed to be a concentration of stops produced in the short-lag VOT region.

By about the age of two, however, most children had acquired the distinction between voiced and voiceless phonemes as measured by significant mean differences of VOT. These studies also showed development toward the adult model over time. Although the details of this developmental course differed from study to study, both the narrowing of the range of within-phoneme-category VOT productions and movement toward the adult mean VOT value in each category were found to be part of the acquisition process in English.

Macken and Barton (1980) also had a follow-up study that looked at acquisition data from Spanish-speaking children. An interesting finding of theirs was that, while Spanish and English both have two-way voice contrasts in their phonological systems, (meaning that there are two and only two stops which differ by phonemic voice at each place of articulation), there was a major discrepancy in the ages at which children learned to reliably separate the voiced and voiceless stops in production.

The English-learning children had acquired the difference by the age of two, whereas the Spanish-learning children did not show production of this contrast even at the age of four. Macken and Barton suggested that this might be due to a spirantization rule in Spanish. That is to say, the children had actually learned spirantization as a way of making the phonemic distinction. Their target voiced phonemes spirantized much more than did their target voiceless phonemes, although they did not yet show consistent spirantization according to the adult rule. Because the children's rule was not yet fully developed, the stop and spirant production targets were confounded, and the children took longer to learn the phonetic values for the clear stops.

Following this argument, it would seem that children are required to have a knowledge of the rules of the phonological system as a whole before they may acquire the phonetic contrasts within a single feature.

Studies of additional languages have been carried out since then. In 1986, Gandour et al did a study of VOT acquisition in Thai, which has the three-way phonemic voicing contrast of voiced, voiceless unaspirated, and voiceless aspirated depicted above. They showed that the Thai-learning three-year olds, (like the Spanish four-year olds), do not have significantly different production times for voiceless unaspirated and voiced stops, even though Thai has nothing like the Spanish spirantization rule to confound the data. The paradox of different ages of phonemic voicing acquisition in different languages would thus appear to be as yet unresolved.

The question then, was whether this discrepancy in VOT acquisition was in fact due to differences in the phonologies of the two languages, or whether there was perhaps a less language-dependent way of accounting for it. In order to investigate the latter possibility, two languages with different phonemic voicing systems were chosen for study.

The present study looks at the acquisition of voice in Hindi and in English. As shown on the above chart, Hindi has a four-way phonemic voicing contrast and English has a two-way contrast.

Methodology

In order to test the production of VOT, flash cards were created for each language which depicted minimally contrasting sets of words which differed only in the voicing of an initial velar stop. All tokens were monosyllabic and none contained open syllables. For example, in English, there was a card with a picture of a goat on it and a card with a picture of a coat on it. There were six different sets for each language. A variety of vowel qualities was tested; results from the four English vowels and the three Hindi vowels shown here are presented below (figure 2).

English picture cards		Hindi picture cards			
goat	coat	kaan "ear"	khaan "mine"	gaan "anthem"	ghaan "quantity"
gate	Kate	kʌn "kernel"	khʌn "floor"	gʌN "group"	ghʌn "cube"
girl	curl	koT "fort"	khoT "flaw"	goT "border"	ghoT "grind"
game	came				

figure 2. Stimuli reported in the present study

The cards were presented in random order to monolingual children ranging from 2 to 6 years of age in individual recording sessions. The children were usually accompanied at the session by their mothers, or occasionally by another adult female (relative or caretaker), who were also recorded for use in determining the adult model.

The subjects were divided into groups according to their chronological age at the time of recording. For the two languages, there were five subjects in each of the four child groups (ie. 2-year-olds, 3-year-olds, 4-year-olds, and 5- and 6-year-olds). There were also ten adults selected at random from each language.

The goal was to obtain five repetitions of each token from each speaker. By and large we were successful. Occasionally, though, a child would object to a certain flashcard and refuse to give more than one or two repetitions, and sometimes a child would enthusiastically give eight or nine repetitions. All repetitions were included in the analysis. Vowel quality turned out not to interact significantly with VOT values for phonemic voice categories according to a three-way analysis of variance, (age, voice, and vowel), with repeated measures on voicing target and vowel.

All data were digitized and measured using the WAVES program at a Sun computer workstation. Spectrograms and waveforms were examined simultaneously in order to ensure an accurate identification of VOT durations.

Both lead and lag times were measured for each repetition of each token. This separation affords a better comparison of VOT values for both Hindi, in which the aspiration duration differences of the voiceless and voiced aspirates (/kh/ and /gh/) have been under question for many years, and in English, where the presence vs. absence of lead voicing is not phonemic. In

these cases, a total measurement of a token's prevoicing and post-release aspiration times together can obscure important facts about the data.

Voicing lead was measured from the start of periodic vocal fold vibration to the point of closure release. Post-release VOT was measured from the release of oral closure to the start of periodic vibration in the following vowel. Pre- and post-release measurements were entered separately in the analysis for the reasons just mentioned and to avoid underreporting the actual amount of lag time produced in the prevoiced tokens.

It is often claimed that the Hindi voiced aspirate has a distinctive production which requires loose, though periodic, vocal fold vibration (known as breathy voice or murmur) throughout the aspirated (post-release) portion of the consonant. This phenomenon was seen to occur in many of the productions, both child and adult, in this study. However, the large number of voiced aspirate repetitions with apparently normal aspiration may imply that voicing during aspiration is not, in fact, a requirement of the Hindi phonology, but rather an optional, (possibly style- or performance-related) production type. When murmur did occur, the post-release but pre-vocalic section was measured as normal lag time.

Aspiration amplitude and fundamental frequency measurements were also taken, in order to determine the acquisition patterns of redundant voicing cues, but only the VOT data are reported here.

Results

The English data for post-release aspiration times appear to confirm the findings of earlier researchers. As shown in the chart below (figure 3), the adult means were about 63ms for /k/ and about 20ms for /g/, with standard deviations of around 17 and 8ms respectively. The children's mean times did not differ substantially from the adults' except that their voiceless stops were a bit longer and their standard deviations were greater (showing less refinement toward the target).

Phoneme - Age Group	Count	Mean(ms)	Std. Dev.(ms)
k - 2	82	75	40
k - 3	154	74	40
k - 4	75	74	52
k - 6	117	74	21
k - Adult	194	63	17
g - 2	79	21	17
g - 3	169	19	13
g - 4	82	25	15
g - 6	111	22	12
g - Adult	211	20	8

figure 3. English Post-Release VOT Means by Age

A pairwise comparison of the VOT means is given below (figure 4). In this chart, the shaded area indicates that there is a significant difference of mean post-release voice onset times between the two phonemes. The numbers below the shaded area give the actual difference, the critical difference required, and the level of significance. The adult mean difference is also given at the left of the chart. The English speaking adults showed a mean production time for the voiceless stop which was about 43ms greater than the mean production time of the voiced stop, which was a highly significant difference. The fact that highly significant differences were evidenced for each age group indicates that the children in the English part of the study had acquired a permanent voicing distinction by the age of two, which confirms the findings of earlier studies.

Age Group

pair		adult difference	A	6	4	3	2
k	g	42 ms	42/2 0001	52/4 0001	49/12 0001	55/6 0001	54/10 0001

diff/crit.diff p-value	significant @ p< .05 Scheffe's S differences rounded to nearest whole millisecond

figure 4. Acquisition of Pairwise Contrasts - English

The table of post-release means and standard deviations for each Hindi phoneme by age group is given below (figure 5). Again, we found the children's standard deviations to be generally greater than the adults'. The Hindi children's mean values were not as adult-like as those of the English-learners.

Phoneme - Age Group	Count	Mean(ms)	Std. Dev.(ms)
k - 2	77	21	18
k - 3	90	23	20
k - 4	86	18	13
k - 6	79	20	13
k - Adult	139	17	8
kh - 2	63	39	25
kh - 3	84	42	24
kh - 4	94	51	20
kh - 6	75	48	19
kh - Adult	158	51	14
g - 2	70	13	15
g - 3	93	21	22
g - 4	95	13	13
g - 6	80	8	10
g - Adult	156	9	10
gh - 2	73	30	23
gh - 3	92	32	26
gh - 4	93	34	24
gh - 6	68	25	24
gh - Adult	147	24	17

figure 5. Hindi Post-Release VOT Means by Age

The following chart of pairwise comparisons (figure 6) illustrates the nature of the adult-child differences noted in the interaction plot above. All pairs are significantly different in the adult group as indicated by the shaded areas in the first column. However, the younger groups do not exhibit acquisition of a contrast for all pairs in all age groups.

The 6-year-olds do not show a significant difference between members of the 1st pair (/gh/ vs. /k/); the 4-year-olds do not reliably distinguish the 2nd pair (/k/ vs. /g/); the 3-year-olds do not show significant mean differences for either of these two pairs, and the two-year-olds don't produce significant differences on either these pairs or the 4th pair (/kh/ vs. /gh/).

pair	adult difference	Age Group A	6	4	3	2
gh k	7ms	7/4 .0001	5/8 .3292	16/8 .0001	8/10 .0754	8/9 .1182
k g	9ms	9/4 .0001	13/8 .0001	4/8 .4304	3/[illegible] .4884	8/10 .0885
gh g	15ms	15/4 .0001	18/8 .0001	20/7 .0001	12/9 .0082	17/10 .0001
kh gh	27ms	27/4 .0001	23/8 .0001	17/7 .0001	10/10 .0408	9/10 .0880
kh k	33ms	33/4 .0001	26/8 .0001	33/8 .0001	19/10 .0001	17/10 .0001
kh g	42ms	42/4 .0001	41/8 .0001	27/7 .0001	22/10 .0001	26/10 .0001

figure 6. Acquisition of Pairwise Contrasts - Hindi

Lead time data is presented, not as a function of mean differences between phoneme targets, but rather as a percentage of the voiced phoneme targets actually produced with lead voicing. Mean lead time differences would be unrevealing here due to the fact that all voiceless targets are assumed to have a lead voicing time of 0ms. (Although discussion is beyond the scope of this paper, it is interesting to note that in the one phonemic contrast in which both members are phonologically voiced, the adults did exhibit a significant difference of -60ms for the /g/ and -52ms for the /gh/.) The table below (figure 7) compares both English and Hindi data from the present study with data reported in Zlatin and Koenigsnecht (1976).

Age	Zlatin & Koenigsnecht English	English all tokens	English without abnormal productions	Hindi
2	4.5%	16%	2.5%	38%
6	8.5%	3%	3%	73%
A	34.3%	12%	12%	99%

figure 7. Percentage of Voiced Target Repetitions Produced with Lead Voicing

The 2-year-olds in the present English study showed some irregular productions of voicing lead. Some repetitions were prenasalized and some had a rather long (more than 20ms) gap of silence between the lead voicing and the closure release. (Allen,1985,reports a similar pre-nasalization phenomenon in the acquisition of lead voicing in French-learning children.) When the irregular productions were removed from the analysis, the percentage of repetitions with lead voicing were more in accord with the Zlatin and Koenigsnecht results. In both Hindi and English the percentage of voiced targets employing lead voicing increases with age.

Discussion

The lag time results of the present study are in accordance with both Macken and Barton studies. The Hindi contrast which is most similar phonetically to the Spanish contrast (i.e. the /k/ vs /g/ pair) has not been acquired at the age of four, but the contrast which is most similar phonetically to the English contrast (i.e. the /k/ vs /kh/ pair) is present even in the two-year old group.

Relying on phonological evidence alone to account for the differences in age of acquisition may make the development process appear more difficult than it needs to be. Macken and Barton's spirantization argument is essentially phonological in nature. By concentrating more on the phonetic contrasts involved in the phonemic distinction, a more straightforward picture emerges.

In other words, when the mean VOT difference between phoneme categories is great, the distinction is acquired quite early, as it is in English and in the fifth Hindi pair. When the mean VOT difference is small, the distinction takes longer to acheive, as in Spanish and in the second Hindi pair.

This explanation would also account for data in the Gandour et al study which shows, among other things, that /p/ and /ph/ are distinguished before /b/ and /p/. The mean VOT difference is much greater in the former pair.

Such a phonetic explanation does not imply that there is no involvement of the phonological system as a whole in the acquisition process. Other factors may interact with the process of learning phonological distinctions through phonetic cues.

For example, note that the two year-olds seem to have acquired a contrast on the third pair, (the voiced aspirate and the voiced unaspirate) before they have acquired the voiced aspirate vs voiceless aspirate distinction (pair four). This is in spite of the fact that the former pair has a mean VOT difference of 12ms less than the latter pair.

Obviously, if the children were using voice onset time differences alone, according to the present theory the reverse order of acquisition should have been the case. A possible explanation for this departure may lie in an across-the-board method of acquisition. Once a distinction has been learned for one contrast, it applies to all other appropriate cases.

Therefore, if the children have acquired the voiceless aspirate vs the voiceless unaspirate distinction early on, due to the large mean VOT difference of the adult model, they may have already concluded that aspiration is phonemic in Hindi. This would allow them to notice and produce the slightly smaller VOT differences in the voiced aspirate/unaspirate pair as well.

It is more difficult to explain why the four-year olds have a contrast while the six year-olds do not on the first pair, and vice versa on the second pair. It should be pointed out, though, that the mean VOT differences of the two pairs are very similar, and it may be due to chance that we see an apparent age-group difference here.

Note that these data are for post-release times only. So, this is not to say that the younger children are lacking a VOT contrast completely in some pairs. They may have indeed noticed that some of these sounds have prevoicing and some of them don't, and may be making some attempts at lead voicing. However, they are not forced to concern themselves with prevoicing at this stage, since reliable post-release differences do exist in the adult model. The presence of prevoicing would, of course, be even less important to the English-learning children since in English, adult voiced stops do not require prevoicing.

The small amount of lead voicing produced by children as compared to adults in both languages (and also in Gandour et al's Thai study), may be a result of its difficulty. Kewley-Port and Preston cite a great deal of articulatory evidence in their 1974 study which supports the argument that lead voicing is acquired last among VOT production types because of the physiological difficulty of producing it. It is reasonable to suppose that children may leave refinement of the more difficult lead voicing until later in the acquisition process.

Conclusion

In view of the acquisition data from the four-way Hindi system, we can posit that there may be a universal pattern of VOT development which depends on the extent of differences in mean VOT times between the adult target phonemes. Children are probably able to differentiate phoneme pairs with extreme VOT differences at an early age. It is only much later that finer differences can be produced accurately.

Therefore, apparent differences in the ages at which similar phonemic distinctions are made across languages may actually be the result of the different phonetic categories employed by those languages.

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Flexibility in Semantic Representations: Children's Ability to Switch among Different Interpretations of "Big"and "Little"

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An important property of language is that word meanings are extremely sensitive to context. For example, Lakoff (1987) argues that words like "mother" and "bachelor" find their meaning in a complex set of cognitive models that vary depending on the context. At times context calls forth the notion of biological motherhood. For example, we may say "Mary Beth Whitehead is Baby M's real mother." At other times context calls forth the notion of mother-as-nurturer, as in "The teacher mothered her students." In other words, even simple nouns and verbs rarely have a single meaning. Instead, context helps us to determine which aspect of a word is called for under particular conditions.

Adjectives also take on their meanings from context. For example, we can identify three distinctly different uses of "big" and "little." One standard is normative: an object is seen by itself and is judged as big or little compared to other objects of the same kind. For example, a hat seen by itself can be judged as big or little for a hat. The hat is compared to some stored mental standard and judged relative to that standard. A second use is perceptual: an object is compared with another object of the same type that is physically present. For example, if there are two hats of different sizes, one can be judged as big or little relative to the other. A third use is functional: an object is judged by how well it fulfills an intended function. For example, a hat can be judged as big or little for a doll, depending upon how well it covers the doll's head.

All three standards are distinct from one another. Although normative and functional standards may seem similar, they are clearly different. A person who has seen a series of "widgets" may judge a new widget as normatively "big" or "little" without knowing how it is intended to function. Similarly, a novel article of clothing that keeps falling off can be judged as functionally "big" even though it may be the only article of its kind the person has ever seen.

The three standards can conflict with one another. For example, a hat that is "little" (normative standard) might be "big" for a doll (functional standard); or a hat that is "big" for a doll (functional standard) might be "little" compared to the hat next to it (perceptual standard). In order to use the words "big" and "little" correctly, people must understand not only the different meanings but also which meaning to use in a particular context. In other words, we have to coordinate among the different standards, so that we choose just the right interpretation in a given context.

This analysis raises a critical developmental problem, since "big" and "little" are among the earliest words learned in English. Use of these terms has been reported before age 2 (Robb & Lord, 1981), and we know from past work that young children use all three standards at an early age (Ebeling & Gelman, 1988; Gelman & Ebeling, 1989; Sera & Smith, 1987).

The question addressed in this paper is how flexible children are when asked to switch from one semantic interpretation to another. Based on recent research in cognitive development, we anticipated that switching would pose difficulties for children. Flavell (1986) reports that 3-year-olds find it difficult to entertain the hypothesis that an object can be simultaneously represented in two different ways. Specifically, they have a hard time focusing on the distinction between what an object really is and what it appears to be. For example, when shown a glass of white milk through a red filter and asked what color the milk really is and what color the milk appears to be, they often give the same answer to both questions. Here we address the issue of whether similar problems arise in

children's interpretations of simple adjectives. For example, is it hard for them to represent an object as both normatively little and functionally big?

In the first study we asked two questions: 1) Are some standards harder than others? and 2) Is switching from one standard to another hard?

Table 1. Conditions and Sample Items used in Study 1.*

NOTE: Underlined items were those that subjects were asked to judge as "big" or "little".

	No Switch	Within-Standard Switch	Across-Standard Switch
Perceptual Conditions:	No-Switch/Percep.	Perceptual/Perceptual	Normative/Perceptual
TRIAL 1:	2" skirt & 4" skirt	3" hat & 5" hat	3" hat
TRIAL 2:	1" hat & 3" hat	1" hat & 3" hat	1" hat & 3" hat
Functional Conditions:	No-Switch/Func.	Functional/Functional	Normative/Functional
TRIAL 1:	2" skirt on 14" doll	3" hat on 14" doll	3" hat
TRIAL 2:	3" hat with 6" doll	3" hat with 6" doll	3" hat with 6" doll

* 8 pairs of trials were used in every condition.

In order to address these questions, we defined two factors that were manipulated to produce six conditions. (See Table 1 for examples.) One factor was the kind of standard: perceptual (children saw two articles of clothing of the same kind--for example, two hats--and judged whether one of them was big or little compared to the other) or functional (children judged whether an article of clothing was big or little for a doll). In other words, we manipulated the standard by varying the stimulus shown with the target article: sometimes it was another article of the same kind of clothing and sometimes it was a doll. While perceptual and functional standards had not been directly compared in previous studies, perceptual standards have been demonstrated in younger children, whereas functional standards have not. We therefore predicted that perceptual standards would be easier than functional standards. By including both standards in our design we could see whether switching poses problems when the task is easy, when it is difficult, or both.

The second factor was the degree of switching. We defined three levels of switching: switching from one standard to another (e.g., judging a hat as normatively little and then as big compared to a smaller hat), switching from one perspective to another while applying a single standard (e.g., judging a hat as little compared to a bigger hat and then as big compared to a littler hat), or no switching (e.g., judging a hat as little compared to a bigger hat; judging a skirt as big compared to a smaller skirt). The task can be thought of as a series of 8 sets of judgments presented in pairs (totalling 16 judgments, 2 trials for

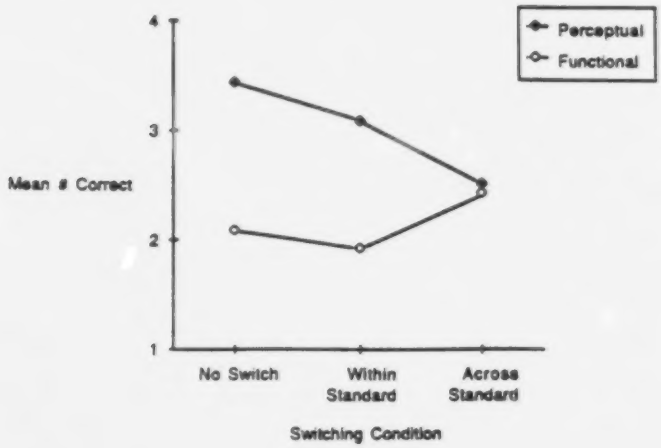
each set). No matter which condition they were in, children judged the same eight target objects (always presented second in each pair). However, the first trial (which set up the degree of switching required) and the object that appeared with the target object (which made it a perceptual or a functional judgment) were different in different conditions.

These manipulations produced six conditions altogether. Three involved perceptual judgments and three involved functional judgments. For each kind of standard, children were faced with one of three kinds of switches: switching from one standard to another, switching from one context to another but using the same standard, or no switch. Subjects were 72 3-year-olds, 12 in each of the six conditions (Ms = 3-8 in each condition). For each question, the children were shown one or two objects and were simply asked if the target object was "big" or "little." In order to help the children to use the appropriate standard, we tailored the wording to the particular kind of question being asked. For normative judgments children were asked, "Is this a big X (e.g., hat) or a little X (hat)?" For perceptual judgments children were asked, "Is this hat big or is it little?" And for functional judgments the wording was, "Is this hat big for the doll or little for the doll?"

In order to get credit for answering correctly, children had to respond correctly to both questions on a given trial. This meant that they were making the correct switch. In order to ensure that differences between groups did not simply reflect performance differences on Trial 1, we first analyzed responses to the first question of each of the 8 pairs of trials. There were no differences between the six groups on the first questions. We then performed a 2 (standard: perceptual vs. functional) x 3 (switching: across standards vs. within a standard vs. no switch) ANOVA with total correct out of 8 as the dependent variable. (See Figure 1.) Results showed that children performed much better in the perceptual conditions ($M = 6.00$) than in the functional conditions ($M = 4.28$) [$F(1,66) = 13.54$, $p < .01$]. It was easier for children to judge one shirt as bigger than another shirt, for example, than to judge it as big for a doll. This finding documents for the first time what we had suspected based on earlier work: that functional standards are more difficult for children.

Figure 1.

Study 1 Results



There was also a marginal standard x degree of switch interaction [$F(2,66) = 2.80$, $p < .07$]. In order to investigate this interaction further, we performed an ANOVA on the scores from each standard separately. This analysis showed that switching had no significant effect when children were making functional judgments, but it did disrupt children's performance in the perceptual conditions [$F(2,33) = 3.43$, $p < .05$]. In the latter conditions, children performed best when no switch was required and worst when they had to switch across standards. For example, when they judged first a normatively little shirt and then that shirt next to an even smaller shirt, performance dropped. As we predicted, shifting from one semantic interpretation to another imposes a cognitive burden on small children.

Switching appeared to have no effect on functional judgments. Performance remained consistently low in all conditions when children judged clothes for a doll. One possible reason for this could be a floor effect: functional standards could be so difficult for 3-year-olds that any effect for switching that might have been observed was washed out. On the other hand, it may be that switching had no effect in this condition because some standard other than functional is preferred and accessed first. In that case, a shift would be inherent in any functional judgment, and the switching manipulation would not have been effective. When children are faced with a functional comparison--when judging a hat for a doll, for example--their first thought may be a normative judgment. That is, they may automatically assess whether the hat is big or little for a hat. If so, then accessing the functional standard will always require a shift from a more preferred (normative or perceptual) standard to a less preferred (functional) standard.

Why does switching disrupt performance at all? One possibility is that switching in itself is difficult. For example, it may be that implicit or explicit memory for the first standard used interferes with the next judgment. In that case, it should be just as hard to switch from a perceptual to a normative standard as from a normative to a perceptual standard. In other words, changing perspective would be inherently burdensome for children. On the other hand, it might be that switching is a problem only if the child is switching from an easier to a more difficult standard. If children prefer one standard over another, there should be an asymmetry in their ability to switch. Going in one direction, switching should be hard. But going in the other direction, switching should pose no problem. The analogy that comes to mind is that it should be easier for a reader to switch from Chomsky to Agatha Christie than it would be to switch from Agatha Christie to Chomsky.

Study 2 was designed to address this issue. Is switching from a perceptual to a normative standard as difficult as switching from a normative to a perceptual standard, or are there asymmetries which suggest that one standard is preferred over another?

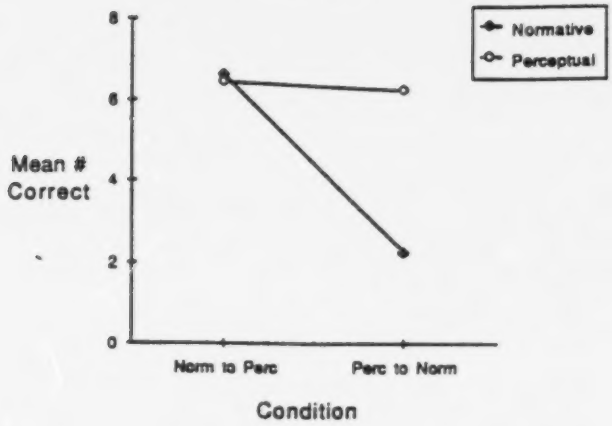
In order to address this question, we compared the twelve 3-year-olds in the normative-to-perceptual condition in Study 1 to 12 additional 3-year-olds in a perceptual-to-normative condition (Ms = 3-8 in each condition). The procedure and items were the same as in Study 1. As discussed earlier, the children in the normative-to-perceptual condition first judged a single object as "big" or "little." Then they judged the same object in the context of another object of the same kind. In contrast, children in the perceptual-to-normative condition first saw the two objects and judged one of them. Then they judged the single object by itself.

Results showed a clear asymmetry in children's ability to switch. (See Figure 2.) There was a condition effect: children performed better in the normative-to-perceptual condition than in the perceptual-to-normative condition [$F(1,22) = 48.60$, $p < .0001$]. There was also a standard effect: children performed better on perceptual judgments than on normative judgments [$F(1,22) = 12.00$, $p < .01$]. Most importantly, there was an interaction between condition and standard: children in the normative-to-perceptual condition

performed well on both normative and perceptual judgments, Ms = 6.58 and 6.42 respectively; children in the perceptual-to-normative condition performed well on the perceptual judgments but poorly on the normative judgments, Ms = 6.25 and 2.25 respectively [$F(1,22) = 14.18$, $p < .01$].

Figure 2.

3-Year-Olds

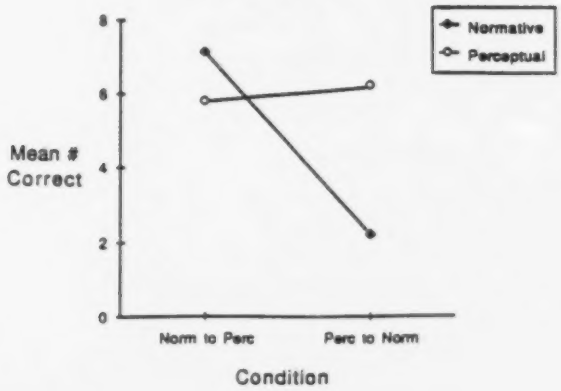


What these results mean is that when switching from a perceptual to a normative standard, children ignored the normative standard. They repeated their perceptual judgment even though it was no longer appropriate. For example, they would say that a tiny 3" shoe was "big"--as if it were still beside the smaller shoe.

A group of nineteen 2-year-olds (Ms = 2-10 in each condition) performed essentially identically to the 3-year-olds. (See Figure 3.) There was a condition effect (children performed better in the normative-to-perceptual condition than in the perceptual-to-normative condition) [$F(1,17) = 20.20$, $p < .0001$] and an interaction between condition and standard (children in the normative-to-perceptual condition performed well on both normative and perceptual judgments, Ms = 7.10 and 5.80 respectively; children in the perceptual-to-normative condition performed well on the perceptual judgments but poorly on the normative judgments, Ms = 6.22 and 2.22 respectively) [$F(1,17) = 14.49$, $p < .01$].

Figure 3.

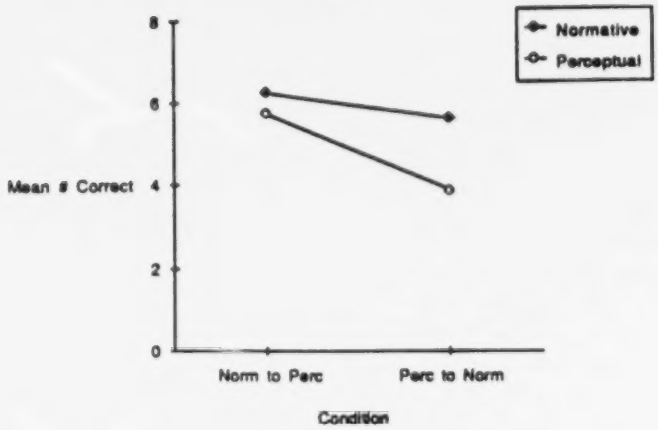
2-Year-Olds



At this point the question arises as to whether there is anything inherent in the task that might be biasing subjects to ignore normative standards when they are shown second. In order to test this idea, we tested a group of 40 undergraduates on the same task. These adults showed the opposite bias to that of the children (see Figure 4). Like the children, they performed better in the normative-to-perceptual switch ($M = 6.00$) than in the perceptual-to-normative switch ($M = 4.77$) [$F(1,38) = 11.02$, $p < .01$]. However, they performed better on normative judgments overall ($M = 5.95$) than on perceptual judgments ($M = 4.82$) [$F(1,38) = 6.31$, $p < .05$]. Thus there is nothing inherent in the task that biases the subject toward a perceptual judgment.

Figure 4.

Adults



To summarize, there were three main findings. First, young children showed impressive flexibility in switching among standards. This was particularly striking with the 2-year-olds. These children could switch repeatedly from normative to perceptual standards, eight times over the course of a few minutes, with performance consistently well above chance. So children can switch among semantic interpretations of a given word.

But the second finding is that switching does come at a cost: when we compared switching to a control (no switch) condition, performance dropped. Even though the items were identical in the no switch and the switching conditions, performance decreased when children had to switch. This means that changing from one semantic representation to another does require effort for young children.

The third finding concerns how different interpretations of "big" and "little" are organized. Children showed a firm preferred ordering of interpretations, with perceptual standards used most easily, then normative, and finally functional. In Study 1 we saw that functional standards were hardest: the children had trouble judging the size of objects for a doll. We still do not know why this is the case, though other work we have conducted suggests that there are probably both linguistic and conceptual problems (Gelman & Ebeling, 1989). In Study 2 we saw that perceptual standards were easiest. This was shown not by initial judgments--both 2- and 3-year-olds easily made both normative and perceptual judgments on Trial 1--but by readiness to switch from one standard to another. Both 2- and 3-year-olds switched readily from normative to perceptual standards but not from perceptual to normative standards. Perceptual standards are more accessible. It is easier to determine that one of two objects is "big" or "little" than to determine that an object

seen alone is "big" or "little."

One interesting point about this ordering is that it lays to rest a very robust misconception about language development. In contrast to what many researchers have suggested (Johnston, 1985; Shaffer, 1985, p. 298), children do not prefer "absolute" interpretations of these adjectives, nor do they find relative meanings difficult to acquire. On the contrary, they appear to be the easiest of all. Children even prefer them erroneously under some conditions. They readily switch to a perceptual standard from another standard, and are reluctant to switch away from a perceptual standard. This preference for perceptual standards is perhaps not so surprising. When information is available in the environment, it is adaptive to use it; when it is not available, it is appropriate to fall back on stored knowledge. Furthermore, perceptual standards are also more basic in the sense that they are simpler (that is, based on only two objects); normative standards develop from integrating many perceptions.

This ordering raises the interesting question of how meanings are organized in memory--are some meanings just easier than others, or are these meanings organized in some way? One line of reasoning that is consistent with our findings is that some meanings are easier than others. Presumably, the easier meaning(s) would emerge earlier, and children would more readily switch from a relatively difficult meaning to an easier one. Both perceptual and normative standards depend upon a comparison of the target object with either another object of the same kind or a composite memory of many other objects of the same kind. An object could be judged as perceptually or normatively "big" or "little" by, in effect, mentally superimposing one image over another. In contrast, a functional judgment requires that one understand the function of the object, identify the relevant parts of the target and the object it is interacting with, and imagine those parts interacting to see whether the goal of the action would be achieved. In other words, the ordering observed in these studies might emerge because it is easiest to make a perceptual judgment, harder to make a normative judgment, and hardest to make a functional judgment. Certainly the fact that functional standards emerge so much later than perceptual and normative standards is consistent with the idea that they are cognitively more difficult than the other standards.

However, it is also possible that the effects we have obtained reveal something about how these meanings are organized in memory. For example, there may be an ordering such that some standards (perceptual and/or normative) are accessed more readily than others. Further research will help us to clarify this.

In sum, the study of how children organize different meanigs of big and little can be viewed as a special case of how children develop a network of meanings for any word. More broadly, this issue arises in the mental representation of homonyms and polysemy. While polysemy has been studied in adults (Small, Cottrell, & Tanenhaus, 1988), the methods used with adults (e.g., reaction time tasks with phoneme monitoring) cannot be used with children. It is our hope that the methods used here will help us begin to understand the development of semantic organization in children.

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MULTIFUNCTIONAL *SE*: COURSE OF DEVELOPMENT IN SPANISH CHILDREN

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The purpose of this paper is to explore the acquisition of *se* by Spanish-speaking children, with a view to examining two issues: (1) the course of acquisition of multifunctional forms and (2) the course of acquisition for a linguistic expression that has both anaphoric and non-anaphoric functions and its relevance to Binding Theory (BT) approaches to the acquisition of reflexives.

Recent research has focused a great deal of attention on the acquisition of reflexive forms (e.g., Chien & Wexler 1987, Hyams 1988, Hyams & Sigurjonsdottir 1988, Wexler & Manzini 1987). These studies have included some work on the acquisition of Spanish *se*, but primarily in its reflexive use (e.g., Padilla Rivera 1985, Solan 1987). Little is known about the child's knowledge of the other uses of *se*.

Spanish *se* is a clitic on verbs that serves a variety of functions, among them the following that are of interest here: (1) Reciprocal: *se* + plural verb (+ optional: *uno al otro* "one to the other"). E.g., *Se quitan las gafas* [SE-take off,3, pl.,pres. the, pl.-glasses "They take each other's glasses off"]. (2) Reflexive: *se* + singular or plural verb (+ optional: *a si mismo(s)* "to himself(herself, themselves)"). E.g., *Se quita el reloj* [SE-take off,3,sg.,pres.-the-watch "He takes his watch off"]. (3) Inherent/Reflexiva Tantum (*se* acts as part of the lexical item): *se* + singular or plural verb. E.g., *Se cae* [SE-fall,3, sg.,pres. "She falls"]. (4) Spurious Dative: *se* acts as a substitute for the pronominal *le(s)* when there are two third-person clitics on the verb. E.g., *Le pone un anillo y* <u>*se lo quita*</u> [IO,3,sg.-put on,3,sg., pres.-a-ring-and-SE-D.O.,3,sg.-take off,3,sg.,pres. "He puts the ring on her and takes it off her"]. (For information on these and other uses, see Garcia 1977, Geniušienė 1987, Manzini 1986, Wehrli 1986.)

There are two main theoretical perspectives that may shed light on the acquisition of these uses of *se*: (1) Karmiloff-Smith's (1979, 1983, 1986) theories regarding the acquisition of multi-functional words, and (2) Binding Theory and its approach to the acquisition of reflexive (anaphoric) and non-anaphoric pronominal forms.

From Karmiloff-Smith's work, we can predict the following course of acquisition. First, from approximately 3 to 5 years, the child will show an early facility with many or all of these uses of *se*. The various uses may be treated as homonymic. At an intermediate stage (at approximately 7 to 10 years), the child may give evidence of associating and pulling together the disparate uses in his or her mental lexicon. There may be some evidence of attempts at differentiating those uses on the surface, either through the use of some ungrammatical constructions or the overspecification of meanings, as the child realizes that there is more than one function for the same form. Especially relevant would be forms like *Se quitan las gafas*, ambiguous between a Reciprocal and a plural Reflexive meaning ("They take off each other's/their own glasses"), and *Se lo pone*, ambiguous between a Reflexive and a Spurious

Dative reading ("He puts it on himself/her"). At an advanced stage (after 10 years), the child should have established a linguistic system in which all or most of the functions of *se* are related. However, overt use of *se* will look similar to that of 3- to 5-year-olds. That is, whatever ungrammaticality or over-specification is in evidence at an intermediate stage should disappear by this point in development.

According to GB Theory and the theory of Universal Grammar, the child is endowed with the Binding Principles innately. (There is, however, room for the maturation of the principles, so they need not necessarily be available from the beginning (Hyams 1988, Borer & Wexler 1987)). Among other things, acquisition entails having to learn which lexical items are anaphors and which are pronominals (and which are referential). The first and second of the above-mentioned uses of *se* are clearly anaphoric uses; use (4) is clearly pronominal. (Use (3) evolved historically from the anaphoric reflexive. See Manzini 1986, Wehrli 1986 for possible GB treatments.)

According to BT, we can predict the following (taking only local binding into consideration):

(1) Early facility with *se*, or at least sudden emergence. (It may take some time for children to realize that an individual lexical item is anaphoric or pronominal, but once they do, they should be able to attach it to the relevant binding principle and use it appropriately.) OR

(2) The child may show initial confusion about *se* because of its anaphoric and non-anaphoric status. (See Solan 1987.) OR

(3) The child may avoid the pronominal use of *se*. Given that this use is less frequent overall than the anaphoric uses of *se*, the child may flag *se* as an anaphor and treat it uniformly so. OR

(4) The child may first learn the separate uses of *se* as homonyms. The child could then learn for each homonym whether it is an anaphor or a pronominal and what its governing category is. If, however, all the *se*'s function in the adult language as a single lexical item, as some have argued (Garcia 1977, Manzini 1986, Wehrli 1986), there may be some later confusion or differentiation of the anaphoric and pronominal uses, as according to Karmiloff-Smith's theories.

(5) If one of the first three possibilities is the case, the acquisition of the use of *se* for the Reciprocal and the Reflexive should be similar. Once the child has realized that *se* is anaphoric, the treatment should be identical.

(6) Further, regardless of which of the first four courses is followed, semantics and pragmatics should not play a role.

And (7), again regardless of which of the first four courses is followed, lexical considerations (which verb *se* is attached to) should not play a role. That is, there should be no evidence of lexically-based acquisition, at least not within a given use of *se*.

METHOD. In this study, children's production of various uses of *se*, as well as non-*se* pronominal clitics, was elicited. Children were shown videotapes and asked to describe what they saw. In the tapes, there were five skits performed by five pairs of actors. Those skits provided contexts in which the uses of *se* or non-*se* clitics were appropriate. There were six opportunities for subjects to produce each of the target-

ed uses of *se* and non-*se* clitics: Reciprocal, Singular Reflexive, Plural Reflexive, Singular Inherent, Plural Inherent, Spurious Dative, and Non-*se* pronominal clitics (*Coge el muñeco y* *lo/le besa* [take,3,sg.,pres.-the-doll-and-D.O.-kiss,3,sg.,pres. "She takes the doll and kisses it"].) For the Reciprocal and Reflexive, the skits also provided two opportunities each to produce 2-clitic constructions (e.g., *Se quita el reloj y* *se lo pone* "She takes off her watch and puts it on").

Children were tested individually. All responses were taped and later transcribed.

Subjects: Subjects were native Spanish speakers, middle and upper middle class children living in Madrid. There were 10 children, 5 boys and 5 girls, at each of 5 age groups: 3, 5, 7, 9, and 11. Mean ages and ranges for these groups were 3;11 (3;7-4;3), 5;3 (4;7-6;0), 7;8 (6;8-8;1), 9;2 (8;7-10;2), and 11;6 (10;6-12;3).

RESULTS. The average number of attempts by each child to refer to each of the targeted types of action was 3.5. X^2 analysis reveals no significant difference in the relative number of times children across age groups produced utterances about the distinct types of action. The accuracy of those attempts was as follows: Singular Inherent 73.8%, Plural Inherent 85.4%, Plural Reflexive 86.4%, Reciprocal 87.8%, Non-*se* 88.1%, Singular Reflexive 90.3%, Spurious Dative 90.7%. Analysis of variance, with Use (Reciprocal, Sing. Reflexive, etc.) a within-subjects variable and Age and Sex across-subjects variables, revealed a main effect of Use ($F=3.34$, $df=6$, $p<.017$), wherein performance on the Singular Inherent was worse than performance on the Reciprocal, Non-*se*, Reflexive Singular, and Spurious Dative *se*. Individual analyses within Uses also revealed an age difference within the Singular Reflexive, with the 3-year-olds performing worse than the children at higher ages.

Both of these results are due primarily to children's use of a plural verb when a singular verb was required. All children showed this type error in the Singular Inherent contexts, and 3-year-olds did so in the Singular Reflexive context. This type error appears to reflect a certain "sloppiness" in referring to the actions in the videos, whereby children would refer to a single person performing an action (*se rie* "she is laughing") with a plural (*se rien* "they are laughing"). The fact that subjects never marked the verb number incorrectly when there was only one person in the picture, only when both persons were present, supports this conclusion.

If we ignore verb number in such cases and take these cases as "correct" (although "sloppy"), we get a different picture. When incorrect verb number is ignored for all cases except that of the Reciprocal, ("sloppiness" is not possible here: use of a singular verb leads to completely ungrammatical results), reanalysis shows a main effect of Use of *se* ($F=7.32$, $df=6$, $p<.001$), wherein the performance on the Reciprocal was worse than performance on all the other uses (Reciprocal 87.8%, Spurious Dative 90.7%, Non-*se* 91.1%, Singular Reflexive 96.8%, Plural Reflexive 97.7%, Singular and Plural Inherent 100%). Given the criteria used for "correct" use, it is not surprising that the Reciprocal should turn out significantly distinct from the rest. But I will return to the Reciprocal below. The reanalyzed figures indicate, however, that lower

performance on the Inherent Singular in the first analysis was due entirely to "sloppiness" in the choice of verb number.

Reanalysis also showed an Age X Use interaction ($F=2.75$, $df=24$, $p<.010$). This interaction reveals that at age 3, performance on the Spurious Dative (58.33%) was worse than that on the Reciprocal (86.11%), the Singular and Plural Reflexive (100%), and the Singular and Plural Inherent (100%), and performance on Non-*se* clitics (66.7%) was worse than that on the Singular and Plural Reflexive, and the Singular and Plural Inherent.

The first of these results (showing Spurious Dative distinct from all but Non-*se*) was due primarily to 3-year-olds' use of only one of the two clitics in the Spurious Dative situations. Examples of these types of errors are M's and J's utterances in reference to a woman sprinkling water on a towel that a man is holding: M: *Se van a lavar con un paño. Lo--Se--Se moja y él lo ha dejado en la silla.* ("They are going to wash themselves with a rag. She wets it--SE--SE, and he has left it on the chair" [should be *se lo moja*].) J: *Mojándole* ("wetting him" [should be *mojándoselo*]).

Results showing Non-*se* distinct from the Reflexive and the Inherent uses are all due to 3-year-olds' use of *se* with the verb *peinar* ("to comb") in a situation in which a woman was combing a man's hair. Subjects should have said "le peina," but 4 out of 10 responses at 3 years were "se peina". Interestingly, the non-*se* clitic required here was *le*, not *lo* or *la*. The only other Non-*se* situation that admitted of *le* (animate object) as an alternative to *lo* or *la* (inanimate objects) [*le besa* (a girl kisses a doll)] never elicited this *se* response.

Looking simply at correct vs. incorrect constructions obscures some differences between children's uses of forms, differences that are relevant to the question of their knowledge of *se*. Of particular interest are the Reciprocal and the Plural Reflexive. A comparison of the distribution of constructions used in the Reciprocal and Plural Reflexive contexts confirms that children show a high degree of knowledge about these structures. The choices of structures are shown in Table 1. With the Plural Reflexive, 97% of utterances involved the use of *se*. Errors consisted primarily of the choice of the singular instead of the plural (21.3% of utterances), which can be attributed to the type of "sloppy" reference found above with the Inherent Singular. With the Reciprocal, only 82.8% of utterances involved *se*. Of these only 8.3% involved use with a singular verb. Examples of these are shown in Table 2. This general avoidance of the singular with the Reciprocal indicates children are sensitive to the ungrammaticality of the singular for the Reciprocal. (However, see discussion below regarding the types of elaborations used by 11-year-olds.)

At the same time, the choice of structures suggests important differences in children's treatment of the Reciprocal and the Reflexive. One form that is used in the Reciprocal contexts that is seldom used in the Reflexive contexts is *le*. This sometimes is used in appropriate constructions in which the child uses a compound, as in Table 3. However, it also occurs in inappropriate or ungrammatical constructions, such as those in Table 4.[1]

Further differences appear on examination of children's elaborations of these two structures. Following Karmiloff-Smith's theories, it is important to know if children in an intermediate age group undergo a period of either producing ungrammatical sentences or overmarking of distinctions for ambiguous structures. In Table 5, the occurrence of elaborations with Reciprocal and Plural Reflexive constructions is

TABLE 1
DISTRIBUTION OF STRUCTURES FOR RECIPROCAL AND PLURAL REFLEXIVE

	Structure Used					
	Se+Sing.	Se+Pl.	Inf.+Se	O+Verb	Le+Sg.	Le+Pl
Recip. Context	8.3	68.0	6.5	7.7	7.6	.7
Pl. Refl. Context	21.3	63.5	12.2	2.0	0	.4

TABLE 2
USES OF SE WITH A SINGULAR VERB IN A RECIPROCAL CONTEXT

AN (3) Uno se está tocando a...otro. (one-SE-is-touching-D.O.,animate-other)
IM (5) Se tira...el niño al padre y el padre al niño. (SE-throw,3,sg.,pres.-the-boy-to the-father-and-the-father-to the-boy)
MI (5) Ahora se está peinando. (now-SE-is-combing)
MI (5) Se--se está dando un beso. (SE--SE-is-giving-a-kiss)
TE (11) Y uno se peina al otro. La chica al chico, y la--el chico a la chica. (and-one-SE-comb,3,sg.,pres.-D.O.,animate-the-other the-girl-to the-boy-and-the--the-boy-to-the-girl)
AL (11) Ahora uno se está peinando el pelo de otro. (now-one-SE-is-combing-the-hair-of the-other)
AB (11) Y se pone...la una a la otra se pone un sombrero. (and-SE-put,3,sg.,pres.-the-one-to-the-other-SE-put,3,sg.,pres.-a-hat)
T (11) Y las dos--una se pone--una le pone el sombrero a otro, y la otra a el. (and-the-two--one-SE-put,3,sg.,pres.--one-IO,3,sg.-put,3,sg.,pres.-the-hat-on-another-and-the-other-on-him)

TABLE 3
(APPROPRIATE) USES OF LE IN COMPOUND CONSTRUCTIONS IN A RECIPROCAL CONTEXT

AB (5) Y faltaban los sombreros. A--Es--Un--Una persona le ha dado su--el gorro a ella y otra--y esta persona le ha dado el--el (gorro). [And the hats were missing. Uh--It is--One--One person has given her--the hat to her and another--and this person has given her the--the hat.]
DA (7) Y la señora...le toca la barba...al señor. Y la--y el señor a la--en la barbilla a la señora. [And the woman touches the man on his beard. And the--and the man on the--the woman on the chin.]
L (9) Y ahora la señora le va a peinar al señor y el señor a la señora. [And now the woman is going to comb the man('s hair) and the man the woman('s).]
LM (11) ...y le está tirando...agua al...al hijo y...el hijo al padre. [and he is throwing water at the son and the son at the father.]

TABLE 4
(INAPPROPRIATE/UNGRAMMATICAL) USES OF LE IN PLURAL CONSTRUCTIONS IN RECIPROCAL CONTEXTS

M (3) Le han metido el (dedo) en la boca. [LE-they have-stuck-the-finger-in-the-mouth]
M (3) Le han puesto el dedo...(a cada lado/acá al lado). [LE-they have-put-the finger-(to-each-side/here-at the-side)
P (3) Y--y le ponen gafas. [And--and-LE-they put on-glasses]
JO (5) Le dan un beso. [LE-they give-a-kiss]

TABLE 5[3]
OCCURRENCE OF ELABORATIONS IN RECIPROCAL AND PLURAL REFLEXIVE CONTEXTS

	Reciprocal			Plural Reflexive		
	1 clitic	2 clitics	TOTAL	1 clitic	2 clitics	TOTAL
3's	5/39	0/7	5/47	0/40	0/15	0/55
	12.8%	0%	10.6%	0%	0%	0%
5's	9/52	2/15	11/67	2/44	1/20	3/64
	17.3%	13.3	16.4%	4.5%	5.0	4.7%
7's	22/59	2/17	24/76	9/54	5/21	14/75
	37.3%	11.8	31.6	16.7%	23.8	18.7%
9's	24/65	2/13	26/78	6/63	7/26	13/89
	36.9%	15.4	33.3	9.5%	26.9	14.6%
11's	17/61	3/19	20/80	5/61	5/22	10/83
	27.9%	15.8	25.0%	8.2%	22.7	12.0%

shown. These data reveal the following: First, the use of elaborations with Reciprocals was much more frequent than with the Plural Reflexive. This held overall and in the 1-clitic construction[3]. Second, there is a considerable increase in the use of elaborations at 7 years of age. Their use remains high through ages 9 and 11. This development with age is fairly consistent with Karmiloff-Smith's work. (The generally greater use of elaborations with one-clitic constructions over two-clitic constructions also supports the view that children are disambiguating. Note that two-clitic constructions occur only in contexts in which referents have already been established. Thus, such utterances are pragmatically unambiguous.)

An examination of the types of elaborations reveals further information. The prevalent elaborations fall into 4 major categories: *uno a(l) otro* ("one to the other"), *los dos* ("both"), a compound, and others (e.g., *juntos* ("together"), *al revés* ("backwards"), *a la mujer* ("to the woman")). The distribution of these elaborations is as in Table 6. Note the following:

(1) For the Reciprocal, there is some evidence at age 7 of children's "pulling apart" of the meaning encoded: There is extensive use of 2 clauses, compounded, with *le* or no clitic.

(2) The elaborations change with age. It appears that children are sorting out the strange syntax of the Reciprocal. (It has a plural verb accompanied by the expression *uno al otro* ("one to the other").) As noted, at 7, there is extensive use of 2 clauses, compounded. At 9, children favor the use of *los dos*; they appear to have learned that the verb must be plural. In fact, two children at this age used the (inappropriate) plural *unos a otros*, as if they were trying to make this expression the subject of the plural verb. At 11, subjects prefer to use *uno a otro* or, sometimes, *mutuamente* ("mutually"). With the former they sometimes try to make the verb singular. They appear to be trying to make *uno* the subject; they even move it to the front, to subject position, where it is never used in the adult language. See examples at the end of Table 2.

(3) The elaborations are not all disambiguating. Note, for example, that *los dos* is used for both the Reciprocal and the Reflexive.

This last observation, along with the fact that there is an asymmetry between the Reciprocal and Reflexive elaborations, noted above, suggests that children's elaborations at ages 7 through 11 reflect something more than simple attempts at disambiguation.

One alternative explanation might draw on the notion of competition (see, e.g., MacWhinney 1987). The child now has available a variety of structures, and these compete for surfacing. However, a simple competition account cannot explain the observed asymmetry between the Reciprocal and Reflexive elaborations. It also cannot account for the greater presence of elaborations with 1-clitic constructions over 2-clitic constructions.

A second possibility draws on Lakoff's (1987) work on radial categories. It appears that the children may be building a radial category for *se* with the Reflexive at the center. The Reflexive can then be taken as the "default" interpretation for *se*, and any deviation from

TABLE 6
DISTRIBUTION OF ELABORATIONS IN RECIPROCAL AND PLURAL REFLEXIVE ONE-CLITIC CONTEXTS

		Uno a(l) otro	Los dos	Compound	Other	Total*
3	Recip.	2	1	-	2	5
	Refl.	-	-	-	-	-
5	Recip.	4	-	2	5	9
	Refl.	-	1	1	-	2
7	Recip.	5	5	11	13	22
	Refl.	-	2	6	1	9
9	Recip.	6	9	6	10	24
	Refl.	-	3	3	-	6
11	Recip.	8	3	5	9	17
	Refl.	-	1	3	1	5

*Note: some utterances had more than one elaboration. Thus, the TOTAL column is not a simple addition of the first four columns.

this use can be marked explicitly as such. This would explain why the "disambiguating" expressions are more rarely added to the Reflexive than to the Reciprocal.[4]

No one of these possibilities alone can explain all of the facts about children's elaborations. The probability is that a combination of these factors is in operation. Only further work will reveal the relative contributions of each factor.

Looking at the data from the point of view of BT:

(1) The children do show a remarkable early facility with *se*, which is consistent with the theory.

(2) Children do not generally show any confusion due to the dual status of *se* as both an anaphor and pronominal. This lack of confusion needs to be explained. One explanation available under BT is to argue that the child is simply learning various homonymic *se*'s and learns the status of each homonym individually. Alternatively, perhaps the child learns early on that Spurious Dative *se* is a special case, which involves a surface-level phonological rule changing *le* to *se*. This *se* need never be associated with the others.

(3) Somewhat harder to explain under BT is the differential behavior of Reflexive *se* vs. Reciprocal *se*. We have seen, first, that there is a difference in confusion with *le*. Reciprocal *se* appears to be associated with *le*, while Reflexive *se* never is. Second, there is an asymmetry in the occurrence of elaborations with these. This difference points to the development of a radial structure for *se*, a structure that is incompatible with a BT account.

(4) In addition, there appears to be some lexical-specific learning. As noted above, for *le peina*, some 3-year-olds produce *se peina*, but they never use *se besa* for *le besa*. This difference is doubtless related to a probable greater frequency of occurrence of *peinar* with *se* in the adult input, including in its use as a "reflexive causative" (see Geniušienė 1987).

(5) Finally, under BT, it is difficult to explain the 11-year-olds' attempts at making *uno* the subject of the Reciprocal sentences in which anaphoric *se* occurs. According to BT, by 11 years of age, children

should have a well-established understanding of the anaphoric status of *se*. It seems implausible that children with such knowledge would try to make *uno* the subject of these sentences.

CONCLUSION. 1. There is an impressive accuracy in young children's production of *se*. This is despite the fact that, according to a BT account, it functions as both an anaphor and a pronominal.

2. Errors in the choice of *se* and *le* are not uni-directional. There is some early overgeneralization of both *se* for *le* (e.g., in *se peina*) and *le* for *se* (in the Reciprocal construction).

3. The data point to a need to incorporate an asymmetry in the status of the different uses of *se*. For at least certain verbs, the Reflexive is located at the center, as the default interpretation; the other uses of *se* are extended in a "motivated" fashion from the Reflexive.

4. There may be a need to incorporate lexical-specific learning in the acquisition of anaphors and pronominals. Children's use of *se peina* for *le peina*, but not *se besa* for *le besa*, may be indicative of a larger problem children learning Spanish have to face as they learn the whole range of Inherent, Reciprocal, Reflexive, and other uses of *se*.

NOTES

[1]The fact that these are errors of le for se, rather than the plural les for se, suggests that the source of the errors lies less in the semantics than in the surface forms of these structures.

[2]Note: Although these elaborations are generally distributed across the lexical items, there is one context for which the Reciprocal never took an elaboration: a man and a woman giving each other a kiss, for which children used se besan/se dan un beso.

[3]This was not the case in the 2-clitic construction. However, on close examination, the frequent use of elaborations with the 2-clitic Reflexive was restricted to a single context: that of a father and son putting shoes on after having removed them. All but 3 of these involved the use of a compound, reflecting a difference in timing as the father and son in the skit put their shoes back on. The other three cases involved the use of los dos.

[4]It may, of course, be more complex than this. It seems that although for some verbs, the Reflexive is the default interpretation, for others, the Reciprocal is (and for others perhaps alternative uses are). For example, recall that Reciprocal utterances with besar ("to kiss") were never accompanied by any elaboration, suggesting that the Reciprocal is the default interpretation for se besan. See note 2.

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PERFORMANCE CONSTRAINTS IN EARLY LANGUAGE: THE CASE OF SUBJECTLESS SENTENCES

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Introduction

The distinction between our knowledge of language (competence) and our use of language (performance) has been a given for most language researchers for 30 years. However, there are at least two views of the competence/performance distinction, the grammatical view and the integrated view. On the grammatical view, performance constraints arise from general cognitive architecture, such as memory and processing limits. For example, Chomsky (1965, p. 3):

> Linguistic theory is concerned with an ideal speaker-listener, ... who is ... unaffected by such grammatically irrelevant conditions as memory limitations, distractions, shifts of attention and interest and errors ...."

Because, on this view, performance constraints are non-linguistic in nature, linguistically regular phenomena can only reflect the competence system. Therefore, in the study of human language, performance constraints are not objects of study unto themselves, but rather impurities that must be filtered in our search for competence in its pristine form.

On the integrated view of competence and performance, language behaviors, such as comprehension and production, are self-contained representational systems that are separate from competence representations. Performance systems integrate constraints on the competence grammar with extra-linguistic processing systems, an integration that can yield linguistically regular data. Furthermore, because performance systems are internally consistent and self-contained, they can be separate objects of study. Examples of this view can be found in those parsers that are separate from particular grammars (e.g., Bever, 1970). Other examples can be found in models of speech production (e.g., Dell, 1986; Garrett, 1975). These may retain the multi-leveled notion of most competence grammars, but often have levels of representation and processes different from those in a grammar. Thus, Dell's speech production model posits a morphological level that is separate from the syntactic level. And Garrett's production model has a positional level at which, both content words are assigned phonological forms, and a sentence frame is created from function morphemes. Neither of these representational levels is typically included in formulations of a competence grammar. Slips of the tongue exemplify how performance systems integrate both processing and competence constraints. These are instances when the system breaks down, reflecting performance constraints. But it breaks down in linguistically regular ways; for example, word substitutions almost always involve words of the same syntactic class.

The view of the competence/performance distinction that child language researchers take often depends on the specific domain of acquisition that they are examining. On the one hand, many child phonologists have adopted the integrated view that performance systems are legitimate objects of investigation. Thus, children are thought to be constructing a production phonology that is constrained by their ability to produce particular motor sequences, by competence constraints on phonological rules, and by a cognitive constraint which pushes for an internally consistent system (e.g., Menn, 1983). On the other hand, researchers who study syntax acquisition are more likely to take the grammatical view that performance constraints are barriers to our direct observation of the more interesting competence system. An example of the grammatical view applied to acquisition is Hyams' (1986) proposal that young English speakers' subjectless sentences reflect an incorrect setting of the pro-drop parameter of Universal Grammar.

This paper contrasts competence vs performance explanations of English speaking children's subjectless sentences. In particular, it reviews evidence indicating that this phenomenon does not reflect linguistic competence, but rather performance constraints. It presents a tentative model of children's production based on an integrated view of compentence and performance to account for subjectless sentences as well as other language acquisition data.

Performance Constraints in Children's Subjectless Sentences

Several researchers have presented evidence indicating that children's subjectless sentences result from performance constraints. For example, Lois Bloom and her colleagues demonstrated that syntactic complexity, lexical unfamiliarity, and discourse primacy all were positively correlated with subject omissions (Bloom, 1970; Bloom, Miller & Hood, 1975). Valian (1989) demonstrated that English speaking children produce more subjects than their Italian counterparts, suggesting that young English speakers actually know that their language requires overt subjects. Valian also demonstrated that English speaking children's subject use increases with increasing MLU, which is not the case in Italian. This suggests that English speaking children's subjectless sentences are due in part to a limitation on the number of morphemes that can be produced in a given utterance. Paul Bloom (1989) has presented data indicating that utterances with longer VPs were less likely to contain subjects than utterances with shorter VPs. This set of facts cannot be easily accounted for within current competence frameworks. However, neither can they be easily accounted for by performance constraints if we accept the grammatical notion of the competence/performance distinction.

On the one hand, we need to explain the regularity of the phenomenon: children show a strong tendency to omit some sentential elements and not others. Such regularity reflects the child's linguistic competence on the grammatical view. On the other hand, there is a correlation between the frequency with which children omit certain sentential elements and the complexity of their intended utterance. Such a correlation reflects the non-linguistic system on the grammatical

view. Thus, the grammatical view forces theorists to deal with one of these issues or the other, but does not allow them to combine both into a single model. For example, Hyams (1986) and others who offer competence explanations for children's omissions focus solely on the regularity of the phenomenon. L. Bloom (1970) has attempted to deal with both issues in a two-part system in which a meta-competence-grammar (her "reduction transformation") exists to respond to processing constraints. Valian (1989) has also attempted to deal with the issues in a two-part system. She has suggested that children use the fact that subjectless sentences are often acceptable in adult English in order to reduce processing load. P. Bloom (1989) has suggested two possible explanations, one focussing on the regularity of the omissions, and the other focussing on the relation between complexity and omissions: (1) children use their pragmatic knowledge that subjects typically contain given information to omit them and thereby reduce processing load (e.g., Greenfield & Smith, 1976); (2) processing constraints allow children to expand utterances rightward only at the expense of leftward elements. What all of these explanations have in common is that the regularity in omissions is treated as reflecting some aspect of the child's linguistic knowledge, while the relation between omission and complexity is treated as reflecting non-linguistic performance constraints.

Contrast these explanations for subjectless sentences with one based on an integrated view of the competence/performance distinction. Here, regularity does not necessarily imply competence, but is reflective of performance systems as well. There are two facts about children's productions that are important for the present discussion: First, added complexity at higher levels of linguistic analysis may adversely affect lower levels. For example, Waterson (1978) discovered that a child's production of a word in isolation is often more phonetically accurate than the same word in a multi-word utterance. This suggests that the syntactic, semantic, and lexical complexity added by the increase from a single word to a multi-word utterance affects the child's production at the phonological level. Second, English speaking children are more likely to omit weak syllables from iambic metrical feet (weak-strong) than from trochaic feet (strong-weak; Allen & Hawkins, 1980; Gerken, Landau & Remez, 1990; Smith, 1973). Thus, giRAFFE is reduced to RAFFE, while MONkey is not reduced to MON.

A Metrical Account of Children's Subjectless Sentences

To test whether this metrical preference can account for English speaking children's subjectless sentences, I asked 18 children with a mean age 27 months and a mean MLU of 2.54 morphemes to imitate sentences in which subjects and objects were either pronouns, proper names, or common NPs (Gerken, 1989, 1990a). Sample stimuli analyzed into metrical feet are shown in 1a-i. (A plus sign signifies a boundary between metrical feet. Capitals signify stressed syllabless, lower case signifies unstressed syllables, underlining signifies weak syllables in iambic feet.) The rules used to assign metrical feet appear in 2a-d.

1a. he KISSED her
1b. he KISSED + JANE
1c. he KISSED + the LAMB
1d. PETE + KISSED her
1e. PETE + KISSED + JANE
1f. PETE + KISSED the + LAMB
1g. the BEAR + KISSED her
1h. the BEAR + KISSED + JANE
1i. the BEAR + KISSED the + LAMB

2a. A foot contains one and only one stressed syllable
2b. Assign exhaustive, maximally binary feet from left to right
2c. Function morphemes, including pronouns, are unstressed
2d. Metrical structure is independent of syntactic structure

Based on the metrically analyzed stimuli in 1a-i, and on the fact that children omit more weak syllables from iambic feet, we can make four predictions about omissions from these sentences: First, children should omit subject pronouns more frequently than object pronouns. This is because subject pronouns always constitute a weak syllable in an iambic foot, whereas object pronouns never occur in iambic feet in these stimuli. Second, because pronouns are weak syllables, subject pronouns should be omitted more frequently than either proper or common NP subjects. Third, because subject articles always constitute a weak syllable in an iambic foot, they should be omitted at the same rate as subject pronouns. And fourth, object articles in sentences with pronoun subjects should be omitted more frequently than object articles in sentences with proper or common NP subjects, and they should be omitted at the same rate as subject pronouns and subject articles. This is because object articles in sentences with pronoun subjects are weak syllables in iambic feet, whereas other object articles are in trochaic feet.

The data from the imitation experiment were consistent with children's spontaneous speech: they omitted more subject NPs than object NPs (see Figure 1), and their MLU's from spontaneous speech correlated signficantly with the frequency of their omissions in the imitation task ($r=.-55$; all reported results are significant at the $p<.05$ level or below by subjects and by items where appropriate). The other predictions were also borne out. Children omitted significantly more pronoun subjects than proper or common NP subjects (for a discussion of why proper or common NPs were omitted at all, see Gerken, 1989, 1990a). Children omitted significantly more subject articles than object articles. And, they omitted more object articles in sentences with pronoun subjects than in sentences with proper or common NP subjects. The latter result is especially important, because it indicates that children are not specifically omitting sentential subjects, but rather weak syllables from iambic feet. Such syllables are statistically more likely to be in subject position, but omission has nothing to do with subjecthood per se. Thus, a range of English speaking children's weak syllable omissions can be accounted for within the same metrical

framework.

Surprisingly, children omitted fewer subjects in sentences with object pronouns than in sentences with either proper or common NP objects. This may be because sentences with pronoun objects (1a, 1d & 1g) have one fewer feet than their counterparts with proper or common NP objects. Therefore, it appears that increasing utterance length in feet taxes the child's processing capacity, resulting in more frequent omissions.

I propose that children's more frequent omission of weak syllables from iambic feet is based on the fact that trochaic feet are the most frequent metrical structure in English. This can be seen in the fact that the vast majority of English words begin with a stressed syllable (Cutler & Carter, 1987). Because trochaic feet are so frequent in English, young English speakers may develop a trochaic production template in service of producing fluent speech. Weak syllables in feet that do not fit the template are omitted. But how can the template account for the findings that there is a relation between omissions and the linguistic complexity of the intended utterance? Figure 2 illustrates a tentative model that is based on models of speech production in adults (e.g, Dell, 1986; Garrett, 1975). This model attempts to provide a unified account for the relation between omissions and linguistic complexity as well as the regularity of children's omissions. In the model, an intended utterance is given a representation at several levels from the intended message to its articulation. Each level of representation has both templates for the canonical structure at that level and rules for creating many non-canonical structures. An intended utterance that can be produced solely with the canonical templates at each level can be produced nearly automatically. Whereas an intended utterance that does not fit the templates at one or more levels requires use of rules and increases the demand for processing resources.

The model explains how complexity at higher levels, (e.g., syntax and morphology) can effect omissions at lower levels, (e.g., metrical & segmental phonology) based on the fact that the further through the production process the intended utterance goes, the more likely it is that it has deviated from one or more templates. Due to resource limitations, template deviations at earlier levels of production necessitate the use of templates at later levels. Thus, an utterance that deviates from the syntactic or morphological template is more likely employ the template at the metrical level than an utterance that violates no templates prior to the metrical level. On this proposal, it is the use of a trochaic metrical template that causes omission of weak syllables from iambic feet.

The model can account for a variety of language acquisition data: If the template at the syntactic level is for intransitive declaratives, then children should be more likely to omit weak syllables in iambic feet from syntactic negatives than from sentences that do fit the template, as found by L. Bloom (1970; Bloom et al, 1975). Similarly, children should be more likely to omit weak syllables from iambic feet in transitive declaratives, as found by P. Bloom (1989). And if the

template at the morphological level is for two or three morphemes at the age in question (as indicated by MLU), then weak syllables in morphologically longer utterances should be omitted. This may explain Valian's (1989) finding that English speaking children's subject use increased with increasing MLU, as well as the more general finding that use of function morphemes increases with MLU (e.g., Brown, 1973). It is also consistent with findings that weak syllable omissions increase with the number of morphemes as opposed to number of syllables (Gerken, 1987; Gerken et al, 1990).

The model has separate representations for foot formation and stress assignment. (See Halle & Vernaud, 1987, for a similar proposal.) This accounts for two aspects of the data from the current experiment: First, it accounts for the finding that children omitted fewer weak syllables from iambic feet in target sentences containing fewer feet in total. Second, if children used the S-W template to both form feet and assign stress, then they should not have omitted object articles from sentences like 1c in those cases where they omitted the subject pronoun. The process of assigning only an S-W template is illustrated in example 3. If the first weak syllable is omitted because it does not fit the S-W template, then the object article falls into a trochaic foot and therefore should not be omitted. An analysis of the data showed that object article omission in sentences like 1c occurred independently of whether the subject pronoun was omitted, suggesting separate representation of foot formation and metrical template assignment. (For a discussion of why children might represent these separately, see Gerken, 1990b.) Finally, the model is consistent with Waterson's (1978) finding that children's segmental accuracy decreases as utterance length increases, because an utterance that deviates from templates at earlier levels will be more likely to employ a template at the phonological level.

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3.  she KISSED the BEAR
        |S    (W)| |S    (W)|
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The model provides an integrated account for both the regularity of children's omissions and their relation to sentence complexity. In particular, it allows the possibility that regular child language phenomena do not necessarily imply linguistic competence, but can also reflect performance systems. It is important to note that the model does not account for the range of data by simply combining all possible factors that may have some effect on children's omissions, but rather it makes testable predictions. For example, violating one template should result in X omissions of weak syllables from iambic feet, and violating two should result in X+Y omissions. It is only by taking the integrated approach to the competence/performance distinction and developing testable models of young children's performance that we will obtain a true picture of their linguistic competence.

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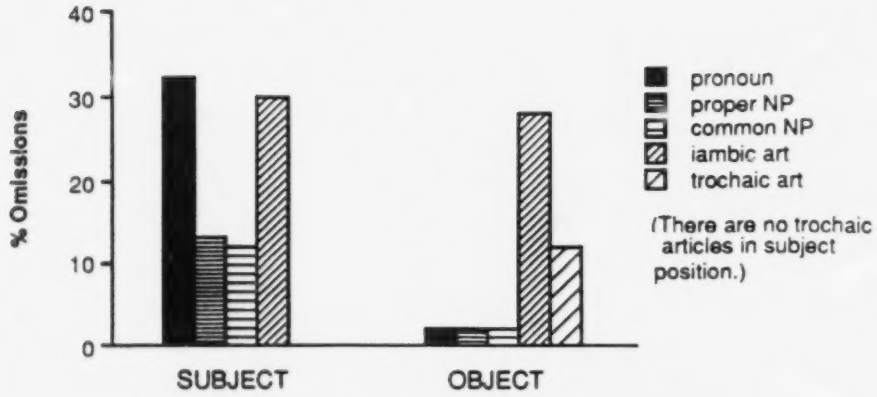

Figure 1, Omissions from Subject and Object Positions

Linguistic Level	Data Accounted For
Message	
Semantic Rules & Templates S -> Agent Action	
Syntactic Rules & Templates S -> Subject Verb	L. Bloom (1970) P. Bloom (1989)
Morphological Rules & Templates | m1 | m2 |	Valian (1989) Gerken (1987) Brown (1973) Waterson (1978)
Foot Formation Rules & Templates | s1 |(s2)| | s1 |(s2)| (s1 or s2 must be strong)	current study (see text)
Metrical Rules & Templates | S |(W)|	weak syllable omission from iambic feet
Phonological Rules & Templates | C | V |(C)|	e.g., consonant cluster reduction

Figure 2, Template Model of Speech Production

(Lower case "m" = morpheme, lower case "s" = syllable)

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OBJECT AFFECTEDNESS AND THE ACQUISITION OF NOVEL VERBS

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It is common these days to hear talk about the relevance of lexical meaning to other levels of representation in the grammar and/or lexicon. The question we address here is whether a particular principle governing the linking of semantic arguments to grammatical functions is relevant to how children actually acquire the argument structure of verbs.

By ARGUMENT STRUCTURE, we mean how a verb expresses its arguments in syntax. For example, let's consider some of the possible argument structures of 'locative' verbs -- verbs involving the transfer of a substance, object, or group of objects to a surface or container. To keep things straight, let's use the gestalt term FIGURE for the stuff that's transferred, and the term GROUND for the surface or container that it's transferred to. These aren't meant to be technical terms; they're just convenient labels. One argument structure can be called the FIGURE-OBJECT FORM because the direct object corresponds to a Figure, such as the water in *Betty poured water into the cup* or the paint in *Tom dripped paint onto the floor*. Another argument structure can be called the GROUND-OBJECT FORM because the direct object corresponds to a Ground, such as the glass in *Mike filled the glass with water* or the bed in *Lloyd covered the bed with a sheet*. Notice that some locative verbs, such as *load* and *stuff*, may appear in either form; *Dan stuffed the hamper with laundry*, *Dan stuffed laundry into the hamper*. These verbs we shall call ALTERNATORS.

Now the question we're interested in is whether a particular principle linking verb meaning and verb syntax determines which argument will be encoded as the direct object and which argument will be encoded as the oblique object. The principle we have in mind, which we shall call the LINKING RULE OF OBJECT AFFECTEDNESS, may be stated as follows:

> An argument is expressed as the direct object of a verb if its referent is specified as affected in a specific way in the semantic representation of the verb.

If we think of the typical locative event, it might be argued that both the Figure and the Ground are to some extent affected; after all, the Figure changes location and the Ground may change state -- for example, from being non-full to being full. The essential thing, however, is not what happens in the world, but rather *what the verb takes* to happen in the world. For example, *pouring* -- essentially -- tells you something about the way a liquid moves: in a cohesive stream. It wouldn't be *pouring* if one drop at a time changed location; that would be *dribbling* or *dripping*. Neither would it be *pouring* if an entire array of drops or particles changed location; that would be *splashing* or *showering*. On the other hand, *pouring* says nothing specific about a container or any other Ground. Certainly one may pour water into a glass, but it would still be *pouring* if the water missed the glass entirely. We can summarize these intuitions by saying that the meaning of *pour* specifies the way in which the Figure is affected, but does not specify the way in which the Ground is affected. According to the linking rule, then, we should expect to find that the direct object of *pour* encodes only the Figure. Indeed it does: one can say *Mary poured water into the glass*, but not **Mary poured the glass with water*.

The verb *fill*, on the other hand, only tells you something about the change of state that a container undergoes; namely, from unfilled to full. It says nothing specific about the substance. Again, you can certainly fill a glass by pouring water into it, but it would still be *filling* if the water dripped into the glass from a faucet. So, the meaning of *fill* specifies the way in which the Ground is affected, but does not specify the way in which the Figure is affected. According to the linking rule, therefore, the direct object of *fill* should encode only the Ground. Sure enough, one can say *John filled the glass with water*, but not **John filled water into the glass*.

Finally, the meaning of the verb *stuff* jointly constrains the particular change of location that the Figure undergoes and the particular change of state that the Ground undergoes. In *stuffing the hamper with clothes*, for instance, the clothing must be forced into the hamper -- perhaps compressing the clothing -- BECAUSE the hamper is being filled to a point where its remaining capacity is too small. According to the linking rule, the direct object of *stuff* should be able to encode either the Figure or the Ground. And this is what we find: *stuff* is an alternator.

The Object Affectedness Rule, as it turns out, may be quite general, applying not only to locative verbs in English but to other argument structures involving a direct object, and in many languages. In fact, there is a considerable amount of evidence for the following universal tendency: affected entities tend to be encoded as direct objects across the languages of the world. Some evidence for this claim comes from the finding that verbs that take an affected entity and an agent as arguments are invariably transitive, with the affected entity encoded as the direct object. Examples from English include causative verbs of change of position in some manner, such as *slide*, or verbs of ingestion, such as *eat*. In contrast, verbs that fall outside this broad semantic class show more variation within and across languages. For example, verbs of emotion may take either the stimulus (e.g., *fear*) or the experiencer (e.g., *scare*) as direct object, and verbs of surface contact (e.g., *hit*) may have their non-agentive argument expressed as the object of a preposition. For discussion, see Levin (1985), Hopper & Thompson (1980), and Talmy (1985).

The evidence for a Universal Tendency of Object Affectedness is quite compelling. The question that we'd like to raise, however, is what EXPLAINS this universal tendency. In four experiments we tested the hypothesis that a CAUSAL relation holds between verb meaning and verb syntax, as formulated in the linking rule of Object Affectedness, and that children as well as adults can use the linking rule to assign syntactic privileges to verbs. Altogether, 216 children (3;4-9;4) and 72 adults were tested. In each experiment, the sample of children was equally divided into three age groups, roughly centered on the ages of 4;0, 5;6, and 7;6. The logic of each of the experiments is the same: children and adults were taught novel or made-up verbs for actions involving the transfer of an object or objects to a surface or container. Subjects were then tested on their willingness to encode the Figure or the Ground as the direct object of the verb. In these experiments, the verbs were always taught with a neutral syntax -- the experimenter would say, for example, *this is mooping* while teaching the verb. The meanings of the verbs, however, were varied according to whether the Figure or Ground is affected in a particular and salient way (but the same Figures and Grounds were always used for both verb meanings in each experiment). In each experiment, it is predicted that children and adults should produce relatively more Figure-object sentences for verbs in which the Figure changes location in a

particular manner, and relatively more Ground-object sentences for verbs in which the Ground changes state in a particular way.

In the first experiment, each subject was taught and tested on two verbs, one at a time. In the manner condition, the experimenter would move a packet of marbles over to a piece of plastic with a zig-zagging manner, while saying (e.g.) *this is mooping*. In the endstate condition, the experimenter would again move a packet of marbles over to a piece of plastic, but this time with a non-descript manner, and with the end result that the piece of plastic would sag down: (e.g.) *this is keating*. Each verb was taught with several pairs of materials, and in addition children were asked to act out the meanings as a check on their comprehension. After a particular verb was taught, we tested the subject's ability to produce sentences with that verb, especially their willingness to encode either the marbles or the plastic as the direct object. Because subjects might have a general preference for one type of syntactic form or the other, masking any potential effect of verb meaning, we elicited sentences in two discourse contexts. In one context each subject was shown the action and then asked, 'what did I do to the MARBLES?' Notice that a natural response to this question is a Figure-object sentence, such as 'You keated the MARBLES onto the plastic'. In a second context, for the same verb meaning, each subject was asked, 'what did I do to the PLASTIC?' A natural response in this context would be a Ground-object sentence, such as 'You keated the PLASTIC with marbles'.

In principle, the frequencies of Figure-object and Ground-object responses are independent because children could fail to provide an unambiguous sentence of either type; in practice, however, ambiguous responses were rare (i.e., 8 out of 2048 elicitation trials (0.4%) in these four experiments). For this reason, and in order to indicate in one index a preference for one type of direct object or the other, we have analyzed the results for Experiment 1, and the other experiments, in terms of DIFFERENCE SCORES: the proportion of trials in which a Figure-object form was produced minus the proportion of trials in which a Ground-object form was produced. Difference scores therefore range from +1.0, a strong preference for the Figure or 'marbles' as direct object, to -1.0, a strong preference for the Ground or 'plastic' as direct object.

Experiment 1: Mean Difference Score for Novel Verbs as a Function of Meaning and Age Group

	AGE GROUP			
	3;4-4;5 (N=16)	4;7-5;11 (N=16)	6;5-8;6 (N=16)	Adult (N=16)
Manner Meaning	+1.00	+1.00	+0.88	+0.62
Endstate Meaning	+0.56	+0.38	+0.06	-0.38

Note: Data are only from the first verb taught to each subject, and comparisons are between subjects; similar results obtain within subject. See Gropen (1989) for a full discussion.

The results of Experiment 1 indicate a highly significant effect of verb meaning -- at $p < .001$ -- confirming our prediction: subjects produced relatively more Figure-object sentences (and relatively fewer Ground-object sentences) for the novel manner verb than for the novel endstate verb. Notice the difference in sign between the meaning conditions

for the adults: they produced absolutely more Figure-object forms for the manner verb, and absolutely more Ground-object forms for the endstate verb. The difference between these means is significant at $p < .02$. Although we don't see this absolute difference in sign for any of the child groups, the difference in means is significant for each child group, marginally so for the youngest and mid-aged children because of a ceiling effect.

The results show that children and adults can use affectedness as the basis for attributing at least SOME syntactic difference in the predicted direction between the verbs. However, we wanted to demonstrate that the observed syntactic difference corresponds to the discrete syntactic judgments that adults ultimately make about English non-alternating verbs like *pour* and *fill*. It would have been nicer, therefore, had we been able to show that the children had an absolute preference to express the manner verb more often in the Figure-object form, and the endstate verb more often in the Ground-object form. Part of the problem, we guessed, had to do with the complexity of the so-called endstate verb, in which the experimenter placed a packet onto a surface, causing the surface to sag. In fact, a post-hoc analysis of children's spontaneous utterances revealed that this action was subject to various interpretations, involving the affectedness of either the Figure or the Ground.

Therefore, in our second experiment we attempted to teach children and adults a purer endstate verb: the Ground changes color, not configuration, and furthermore the proximal cause of the change is chemical, not the motion of an impinging Figure. This should make subjects less likely to focus on the motion of the Figure. In designing this verb we took advantage of the fact that the juice from a red cabbage is a natural indicator; that is, the color of unadulterated cabbage juice is purple; if you add lemon juice to it, it turns pink; if you add a baking-soda solution to it, it turns green; if you add water to it, it stays purple. So, before the experimental sessions we soaked pieces of felt or absorbent paper in cabbage juice, and cotton balls or little sponges in water, lemon juice, or baking-soda solution. In the endstate condition, the experimenter moved a cotton ball over to a piece of felt with a nondescript manner, and the felt changed color from purple to either pink or green. *This is mooping*. In the manner condition, the experimenter would move a cotton ball over to a piece of felt with a zig-zagging or hopping manner, while saying (e.g.) *this is keating*. But this time there would be no color change because the cotton ball was damp only with water.

Before presenting the results, we must report that our plan to design a pure endstate verb apparently worked; the spontaneous utterances of the children showed that they understood the essential nature of a specific color change to the meaning of the endstate verb. Here are the results:

Experiment 2: Mean Difference Score for Novel Verbs as a Function of Meaning and Age Group

	AGE GROUP			
	3;5-4;5 (N=16)	4;7-5;8 (N=16)	6;7-8;5 (N=16)	Adult (N=16)
Manner Meaning	+0.38	+0.62	+0.88	+0.62
Endstate Meaning	-0.88	-1.00	-1.00	-1.00

Note: Data are only from the first verb taught to each subject, and comparisons are between subjects; similar results obtain within subject. See Gropen (1989) for a full discussion.

As should be fairly clear, we again found a very large effect of verb meaning -- in fact, it's a larger effect of verb meaning than we found in the previous experiment. The effect is highly significant not only for the adults, but for each of the child groups as well. Furthermore, this larger effect is entirely due to a shift in the difference scores for the endstate verb; the endstate score for the youngest children is significantly lower than zero according to a two-tailed *t*-test, and the rest of the endstate scores are at floor. In contrast, the manner scores are significantly greater than zero for every group except the youngest children. In sum, the results of this experiment, and the last, support our hypothesis that children and adults can assign a difference in the syntax of novel verbs on the basis of whether the Figure or the Ground is affected according to their meanings. Moreover, the difference in absolute preference that we found here corresponds to the discrete syntactic judgments that adults ultimately make about non-alternating verbs like *pour* and *fill*.

In our third and fourth experiments, we decided to test a more subtle variety of Affectedness which applies not to non-alternating verbs such as *pour* and *fill*, but to alternating verbs such as *stuff* and *load*. This variety of Affectedness has been called the "holism" effect because the Ground-object form of the verb carries the necessary implication that the Ground is totally or holistically affected. For example, the sentence *John loaded the cart with apples* implies that the cart ends up full of apples. On the other hand, the Figure-object sentence *John loaded apples into the cart* carries no such implication; John may have put a few apples into the cart, leaving most of the cart empty. The holism effect has been found not only for the English locative alternation, but also for the locative and other direct-object alternations in a variety of languages (see Green, 1974; Moravscik, 1978; Hopper & Thompson, 1980; Foley & Van Valin, 1985; Levin, 1985; Rappaport & Levin, 1988; Gropen, 1989; Pinker, 1989).

In Experiment 3, we wanted to test the ability of subjects to attribute syntactic differences to verbs which vary only in whether or not the Ground is holistically affected. Children and adults were randomly assigned to one of two between-subjects groups. In the partitive condition, for example, one peg would be placed into a hole on a board; *this is keating*. In the holistic condition, the same action would be repeated until all the holes on the board were plugged with pegs. We predicted that if children and adults were sensitive to this variety of Affectedness they should avoid uttering Ground-object forms in the partitive condition, because in that condition the Ground is not holistically affected.
The results bear out this prediction:

Experiment 3: Mean Difference Score for Novel Verbs as a Function of Meaning and Age Group

	AGE GROUP			
	3;5-4;10 (N=16)	5;0-6;11 (N=16)	7;0-9;4 (N=16)	Adult (N=16)
Partitive Meaning	+0.72	+0.75	+0.47	+0.56
Holistic Meaning	+0.28	-0.09	+0.38	+0.41

According to two-tailed *t*-tests, the difference scores for subjects in the partitive condition were significantly greater than zero for every age group except the oldest children. In other words, subjects in the partitive condition selectively avoided uttering the Ground-object sentence, presumably for the same reason that they would avoid saying *John loaded the cart with apples* in the situation where most of the cart remained empty. In contrast, the difference scores for subjects in the holistic condition were not significantly different from zero for any of the age groups. Furthermore, we found a significant effect of verb meaning for the combined subjects and for the combined child groups; children and adults produced relatively more Figure-object sentences in the partitive-verb condition and relatively more Ground-object sentences in the holistic-verb condition. The direction and size of the effect are exactly as we would expect with verb meanings of this sort.

In Experiments 1, 2, and 3, the challenge was to manipulate verb meaning as an independent variable, but one of the first things we learned was that we couldn't completely control how a subject was going to interpret a novel verb. In Experiment 4 we decided to take a slightly different tack, with the hope of showing that the same event could be construed in different ways, leading to differences in syntax. Our method was essentially to present every subject with the same AMBIGUOUS action, find out how they construed the action, and then find out how they would express in syntax a novel verb for that action. In particular, the ambiguous action that we presented to subjects was a version of the holistic verb that we used in Experiment 3. For example, the experimenter repeatedly placed little strips of felt onto a board, one at a time, until the surface of the board was completely covered. Notice that this action can be interpreted in two ways: either as a way of affecting objects by PUTTING them onto a surface or as a way of affecting a surface by COVERING it with objects. So, before we had subjects learn a novel verb for the action, such as *keat*, and produce sentences with it, we simply asked them to use either the verb *put* or the verb *cover* to describe the new action. The prediction is that subjects who chose *put* would produce relatively more Figure-object sentences with the novel verb, and that subjects who chose *cover* would produce relatively more Ground-object forms with the novel verb. Here are the results:

Experiment 4: Mean Difference Score for the Novel Verb as a Function of Choice of *Put/Cover* and Age Group

	AGE GROUP			
	3;7-4;10 (N=13)	5;0-6;10 (N=12)	7;2-9;1 (N=8)	Adult (N=15)
Subjects Choosing *Put*	+0.06	-0.31	-0.19	+0.08
Subjects Choosing *Cover*	-0.79	-0.97	-0.62	-0.79

As predicted, we found that subjects who chose *cover* have a lower mean difference score than those who chose *put*, highly significant at $p < .001$. For each age group, the difference score is always lower for those subjects choosing *cover*, significantly so for every group except the small sample of oldest children. In addition, the difference score for each of these groups choosing *cover* is significantly less than zero. These findings show that subjects who interpreted the novel action as a way of affecting a surface by covering it, rather than as a way of affecting objects by putting them onto a surface, produced relatively

more Ground-object sentences with a novel verb for that action. Such subjects also had an absolute preference for the Ground-object form with the novel verb.

In summary, we were able to predict the syntactic privileges that subjects would assign to novel verbs in each of four separate experiments: we found that relatively more Figure-object sentences were produced with verbs for which the Figure was affected, and relatively more Ground-object sentences were produced with verbs for which the Ground was affected. In addition, we were able in most cases to explain children's absolute preferences, or lack thereof, for one type of syntax or the other. On the basis of these results we suggest that a causal relation holds between verb meaning and verb syntax, as formulated in the linking rule of Object Affectedness, and that something like this rule MUST be used under some circumstances.

The question, of course, is what those circumstances are: have we tapped into something that has some generality and importance in the language acquisition process? We think we have: children may actually use linking rules in learning which verbs permit alternations between argument structures. Some evidence for this claim comes from the correlation of syntactic and semantic ERRORS in children's speech. For example, Bowerman (1982) found that children between the ages of four and seven often overuse the Figure-object form, producing sentences such as **Can I fill some salt into the bear?* [referring to a bear-shaped salt shaker]. Errors of the other type, involving incorrect Ground-object forms (e.g., **I poured you with water*), also occur, but are much rarer. In Gropen, Pinker, Hollander, & Goldberg (in press) we suggested an explanation for these errors: if children are prone to systematic mistakes in verb meaning, such as the mis-specification of which entity is affected, the affectedness linking rule, even when applied correctly, would yield syntactic errors. We also noted that there was independent evidence that children are prone to making systematic errors in verb meaning, having more difficulty acquiring meaning components relevant to changes of state than components relevant to changes of location (Gentner, 1978). Thus on this account if a child erroneously thought that a Ground-object verb such as *fill* specified a particular manner of motion of the content argument (e.g., pouring), he or she could derive a Figure-object form from it and would produce errors like *fill the water*. In fact, in two experiments we showed that children between the ages of 2;6 and 8;9 not only have a tendency to make more *fill the water* than *pour the glass* errors in their speech, but that they are also more likely to misrepresent the meaning of *fill* than the meaning of *pour* in comprehension. Unlike adults, they often interpreted *fill* as implying that something be poured, even if the container ended up not full. Furthermore, there was even a weak tendency for the individual children who misinterpreted verbs like *fill* to be more likely to make syntactic errors with such verbs, errors in which the content was used as the direct object.

An important question which remains is precisely how, in the normal course of language acquisition, children learn which verbs specify which entities as affected, and in particular which verbs may specify either entity as affected. We suggest that children learn to restrict productive extension of the locative alternation within particular narrow, semantically cohesive subclasses of verbs (see Levin, 1985). For example, verbs involving forced directed motion of a substance alternate (*splash the water/splash the wall*; also *inject*, *splatter*, *spray*), but verbs involving gravity as the impetus for the motion of a substance do not (*pour the water/*pour the glass*; also *spill*, *ladle*, *drip*). This is a topic taken up in detail in Pinker (1989) and in Gropen (1989).

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ACQUIRING PROPER NAMES FOR FAMILIAR AND UNFAMILIAR ANIMATE OBJECTS: EVIDENCE FROM TWO-YEAR-OLDS

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When children hear a new word for an object, they have to decide, among other things, whether the word is a proper name that refers to the individual (e.g., "Garfield") or a common count noun that refers to an object kind of which the individual is a member (e.g., "the cat"). Two types of knowledge may help word learners decide correctly whether a word is a proper or a common noun. One source of knowledge is semantic: properties of particular kinds of objects make them good candidates for receiving proper names. For example, children may realize that the individuality of the members of many kinds of animate objects, like people and pets, is important, but that the individuality of members of other kinds, such as pencils or socks, is not. A second source of knowledge is syntactic: certain linguistic cues make some words better candidates for being proper names. For example, children may know that in English, determiners precede common names; we say "a cat" or "the pet". They may also know that proper nouns are typically not preceded by determiners; we say "Garfield".

Two previous studies have examined the acquisition of proper and common nouns in young children. The first of these was a seminal study by Katz, Baker, and Macnamara (1974) in which 2-year-olds learned a new word for a familiar object. The word was modeled either as a proper name (e.g., "This is Zav") or as a common noun (e.g., "This is a zav"), and the object was either a doll or a block. Children were asked to perform a series of actions with "Zav" or "a zav", including feeding the doll or putting the block in a house. Katz et al. looked at the percentage of times children chose the named object when performing the various actions. If a child chose the named toy consistently, then they inferred that the child had made a proper name interpretation. If a child chose randomly between the two toys, they inferred that the child had made an interpretation that was consistent with a common noun.

Katz et al. found that their 2-year-olds used both semantic and syntactic knowledge in interpreting the new words. Specificially, they found that the syntactic form of the word--whether it was modeled as a common noun or as a proper noun--affected children's selections for the dolls, but not for the blocks. Children who were taught a proper noun for a doll frequently selected the named doll (on 75% of trials). Children who were taught a common noun for a doll chose randomly between the two dolls, consistent with a common noun interpretation. Children who learned either a proper name or a common name for a block chose randomly between the two objects. Katz. et al. interpreted their results as showing that very young children know that the individuality of members of certain familiar kinds (e.g., dolls) is important, and that this individuality is marked linguistically in a particular way, that is, through the use of proper names.

The second study that examined the acquisition of common and proper names was Gelman and Taylor (1984). This study replicated the Katz et al. results, although the procedure differed in several ways. In addition to elaborating and standardizing the test

procedure in important ways, one of their principal changes was to use toys that were unfamiliar to the children. The authors pointed out that the children in the original study probably already knew that the objects were "dolls" or "blocks". They switched to unfamiliar objects--novel creatures instead of dolls, novel toys instead of blocks--to remove the possibility that the children had been confused because of a preference not to accept a new common noun for an object with a known label.

With these changes to the procedure, Gelman and Taylor replicated the Katz et al. findings, by again showing that for stuffed unfamiliar creatures, children made frequent proper name interpretations of a word modeled as a proper name. On 69% of trials, children selected the named object. In no other condition did children make a consistent proper name interpretation, consistent with the Katz et al. findings.

The results from these studies suggest that children are sensitive to both semantic and syntactic cues in acquiring proper and common nouns, regardless of whether the named objects are familiar or unfamiliar. Yet while it would not be safe to compare directly the results of the two preceding studies because of considerable procedural differences, it is interesting to consider these results in light of other recent experimental evidence suggesting striking differences between young children's interpretations of new words for familiar and unfamiliar objects.

Soja, Carey, and Spelke (in press; Soja, 1990) have suggested that when young children hear a new word for an unfamiliar object, they think that the word refers to a kind of object, regardless of the word's syntactic frame. These authors have reported that 2-year-olds' interpretations of novel words for unfamiliar objects did not differ, whether the syntax suggested a count noun interpretation ("This is a blicket"), a mass noun interpretation ("This is blicket"), or neither such interpretation ("This is my blicket"). Under all syntactic conditions, children made equally frequent object kind interpretations.

Markman and Wachtel (1988) found that 3-year-olds will override clear syntactic cues in order to interpret the first word for an unfamiliar object as referring to the kind of object. Children who heard "See this? It's pewter" (a novel word modeled as a mass noun) applied to an unfamiliar object (pewter tongs) often interpreted the word as an object kind term by extending it to other tongs (not made of pewter). Only children who learned the new label for an already familiar object (for example, a cup) used the syntax appropriately to interpret the word as referring to the substance the object was made of.

The Soja et al. (1990) and Markman and Wachtel (1988) results thus showed that children will override mass noun syntax to interpret a new word as a common count noun referring to a kind of objects. However, it also follows from the object kind bias hypothesis that young children should not interpret the first words for unfamiliar objects as proper names, irrespective of whether the interpretation violates syntactic information. Markman and Wachtel (1988) made this prediction explicitly: "...when children hear someone label an object, they assume that the label refers to...the object category...and not to the object as a specific individual...[among other things]" (p. 122). However, this prediction has not yet been directly tested. The previous two studies of common and proper name acquisition have shown that children respected syntactic cues and made proper noun interpretations of intended proper names for animate objects, when the referent was

either familiar or unfamiliar. However, neither study directly compared unfamiliar and familiar objects.

The two studies I'll describe now were designed to assess clearly the relative strengths of the object kind bias and syntactic knowledge in 2-year-olds' inductions of word meaning. Which was more relevant to 2-year-olds' semantic inferences--the object kind bias or proper noun syntax? These studies compared children's interpretations of novel proper names for familiar and unfamiliar objects to find out.

Experiment 1

In the first study, twenty 2-year-old children participated. They ranged in age from 2-3 to 3-0, with a mean age of 2-8. Ten children were assigned randomly to each of two conditions, Familiar and Unfamiliar, with approximately equal numbers of boys and girls. Children were tested in only one condition.

The procedure was adapted from Gelman and Taylor (1984). In each condition, four stuffed toys were used. In the Unfamiliar condition, there were two unfamiliar monster-like animals of the same kind and two distractor creatures. The first pair of monsters were covered with blue fur. They looked identical except for their dress, which consisted of a hooded cape. These garments were made in two distinct materials and colors. The distractor items consisted of one familiar animal (a rabbit), and one unfamiliar monster-like animal of a different kind. The monster-like creatures were undoubtedly novel to the children. As an informal check of their unfamiliarity, however, they were shown to a group of eight 3- and 4-year-old children who were asked whether they had ever seen the kinds of things before. No child admitted ever having seen them before.

In the Familiar condition, the toys were two cats and two distractors. The cats were striped, and they looked identical except for their dress, which again consisted of hooded capes of the same materials and colors that were used to dress the unfamiliar monsters. The distractors were the same as in the Unfamiliar condition.

There were two parts to the study: a naming portion followed by a testing portion. In the naming portion, the experimenter placed a box in front of the child, removed one of the four toys from it, and showed it to the child. In the Unfamiliar condition, the child saw one member of the pair of monsters and was invited to handle the creature briefly. The experimenter used only the word "this" or "this one" to refer to the object. The experimenter then labeled the monster with a proper name in the following manner: "See? This is Zav". The child was asked to repeat the label. The experimenter then repeated the label in the same syntactic frame at least five times. In the Familiar condition, one of the two cats was shown. Many children spontaneously called the animal "a cat", "a kitty", or "a kitty-cat". In any case, the experimenter invited the child to handle the stuffed animal briefly, as in the Unfamiliar condition. During this time, the experimenter used the label "cat" to refer to the object, allowing the child either to hear that the experimenter agreed with the child's spontaneous label or, at least, to hear the object's familiar label. The experimenter then labeled the cat with a word modeled as a proper noun, exactly as in the Unfamiliar condition: "See? This is Zav". Again, the child was asked to repeat the label, and the experimenter then repeated the label at least five times.

To begin the testing portion of the task, the experimenter took the three remaining toys out of the box, one at a time, and placed them in front of the child. The experimenter then asked the child to carry out a series of 10 simple actions. Six of these actions were designated as test trials. On these trials, the experimenter asked the child to choose an object in response to a request that included the new name (e.g., "Can you put Zav behind your back?", "Can you put Zav in the box?"). On the four remaining filler trials, the experimenter told the child which object to handle (e.g., "Can you put this behind your back?", "Can you put that in the box?"). Each of the four toys was used once as a filler item, to decrease the likelihood that children would select any toy simply to handle it. The child could easily reach all four toys at all times.

Before considering the results, recall the prediction: To the extent that the object kind bias can override syntactic cues, these 2-year-olds should be more likely to select the named toy in the Familiar than in the Unfamiliar condition on the test trials.

To code the results, children were first given three scores to reflect the percentage of test trials (out of a total of six) on which they chose the named toy, the other toy of the same kind, or one of the distractor items.

The results showed clear differences between children's performance in the two conditions. In the Unfamiliar condition, they selected the named toy on 65% of test trials, the other member of the named kind on 33% of trials, and one of the distractors on 2% of trials. However, in the Familiar condition, they selected the named toy on 92% of trials. A t-test revealed that children were more likely to select the named toy in the Familiar than in the Unfamiliar condition ($t(18) = 3.01$, $p = 0.008$).

A more conservative coding of the data classified children into one of two groups according to whether they selected only the named toy across all test trials. This measure of the tendency to make a proper name interpretation is quite stringent. This stringency is not unrealistic, however, given that in real life proper nouns are used categorically, not probabilistically, to pick out individuals. A person cannot be said to be using "Garfield" as a proper name if the person uses it some or most of the time to refer uniquely to Garfield, but other times to refer to other cats (who are not called "Garfield"). If the 2-year-olds in this study had made a proper noun interpretation of the word, then they should never have selected anything other than the named toy, assuming that they could discriminate between toys of the same kind. Crucially, the discriminability of the two objects was controlled to a considerable extent between the Familiar and Unfamiliar conditions through the use of similar dress.

When children were classified in this way, a compelling difference emerged. While only 2 of the 10 children in the Unfamiliar condition chose only the named toy on all test trials, 8 of the 10 children in the Familiar condition selected only the named toy. This difference is significant by Fisher's exact test, $p = 0.011$.

While these results show a clear difference between children's performance in the Familiar and Unfamiliar conditions, two considerations suggest the value of a follow-up study. First, it would be valuable to check that the effect obtained in Experiment 1 held up with new stimuli. Thus, in Experiment 2, dogs replaced cats in the Familiar condition, and

different kinds of unfamiliar monsters were used in the Unfamiliar condition. The pairs of creatures again wore hooded capes of different materials and colors, and again the familiar creatures (the dogs) and the unfamiliar creatures were dressed in a similar manner. As a second consideration, it would be revealing to introduce the proper names under different circumstances. It is true that the stimuli used in Experiment 1 were all animate stuffed animals and presumably good candidates for receiving proper names. However, it could be that very young children rely on the semantic cue that only friends or family members (people or pets) can receive proper names. To address this concern, the procedure in Experiment 2 was modified slightly so that a hand puppet introduced the named toy (either familiar or unfamiliar) as his "pet". If children in the Unfamiliar condition had been reluctant to learn a proper name for a monster-like animal because they did not think a monster could possibly receive a proper name, then this modification should help to rule out that alternative. Everything else about Experiment 2 was the same as Experiment 1.

Experiment 2

Twenty 2-year-olds, with a mean age of 2-8, participated in this study. None had participated in Experiment 1.

The results were very similar to those from Experiment 1. As in Experiment 1, children were first given three scores to reflect the percentage of test trials on which they chose the named toy, the other member of the same object kind, and one of the distractor items.

In the Unfamiliar condition, they selected the named toy on 62% of trials, the other member of the named kind on 33% of trials, and one of the distractors on 5% of trials. However, in the Familiar condition, they selected the named toy on 88% of trials. A t-test showed that children were more likely to select the named toy in the Familiar than in the Unfamiliar condition ($t(18) = 2.59$, $p = 0.018$).

With the more conservative criterion whereby children were classified as having made a proper name interpretation if they selected only the named toy across all test trials, only 2 of the 10 children in the Unfamiliar condition made a proper name interpretation, while 7 of the 10 children in the Familiar condition made a proper name interpretation. This difference is significant by Fisher's exact test, $p = 0.035$.

Even in this replication designed to test the hypothesis with new stimuli and to examine acquisition under different teaching circumstances, children were more likely to make a proper name interpretation of a proper name applied to an animal when the animal was familiar than when it was unfamiliar. The difference between unfamiliar and familiar toys was again more striking when the dependent measure was the number of children who focused exclusively on the named toy. Knowing that the unfamiliar object could be labeled with the familiar superordinate count noun "pet" thus did not remove children's preference to interpret the novel proper name as referring to a kind of objects. This finding suggests that the object kind bias is an expectation for a lower-level kind label, presumably a basic-level kind label, for an unfamiliar object (cf. Rosch et al., 1976).

Children's Spontaneous Comments

In addition to the preceding data on children's object selections, a final source of data was perhaps most revealing of all. During the task, many children made spontaneous comments, especially when the toys were first all presented or when a particular toy was used on a filler trial. Given the young age of these children, these comments were quite striking. The patterns of occurrence of two types of comment were most revealing.

One type, to be called a common noun comment, involved a child's spontaneously and explicitly extending the novel label to the other member of the named kind, treating it syntactically as a common noun (e.g., by pluralizing it or by combining it with a determiner). These comments are revealing because all children had heard the word modeled only as a proper name (e.g., "This is Zav").

Consider a few of these comments:

Girl, 2-5. Pointing first to the other member of the same kind, then to the named toy, she said, "Two zavs! Two zavs again! Two zavs!". Asked to "put Zav in the box", she responded, "Two zavs in the box. I want to put two zavs in the box!"

Boy, 2-4. Pointing to the other member of the same kind, he said, "That a dax!"

Girl, 2-9. Pointing to the other member of the same kind, she said, "That's another zav! Two zavs!"

A second type of spontaneous comment, to be called a proper noun comment, revealed a proper name interpretation of the label. It occurred whenever a child spontaneously and explicitly restricted the label to the named toy, for example, when the child pointed to the unnamed kind member and asked what it was called.

Consider these examples of proper name comments:

Boy, 2-11. When the other member of the same kind was brought out, he touched it, and asked, "Who is this name?"

Boy, 2-9. When the other member of the same kind was brought out, he held it up and asked, "What's this called?"

Boy, 2-9. Pointing to the unnamed member of the same kind, he asked, "Who's this? Who's this one?"

If children had treated the novel labels equivalently in the two conditions, then these two kinds of comments (common noun comments and proper noun comments) should have been distributed equally between the two conditions. However, to the extent that the object kind bias overrode syntactic evidence, then common noun comments should have been more prevalent in the Unfamiliar condition, while proper name comments should have occurred more frequently in the Familiar condition. Indeed, a Fisher's exact test supported this hypothesis: $p = 0.024$. Seven of the 8 children who made common noun comments

were in the Unfamiliar conditions. All 3 of the children who made proper name comments were in the Familiar conditions.

Discussion

Two studies examined 2-year olds' interpretations of novel proper names for familiar and unfamiliar objects. In the first study, children were more likely to interpret novel proper names appropriately when the words were applied to familiar than to unfamiliar animals. When the animals were unfamiliar, children frequently interpreted the words as common nouns, disregarding the proper name syntactic cues. When the animals were familiar, children were reliably more likely to interpret the words as proper names, making appropriate use of the proper name syntax. The second study replicated this result when the stimuli were different and when children were introduced to the named object by a puppet who used the familiar superordinate term "pet".

The finding from the first study, that children frequently interpreted words intended to be proper names as common nouns when the objects were unfamiliar, is strong evidence for the claim that the first words learned for such objects are taken to refer to a kind of objects, irrespective of the syntactic form of the word (cf. Soja et al., 1990; Soja, 1990; Markman and Wachtel, 1988). The result from the second study refines this claim by suggesting that the object kind bias is a bias to acquire a lower-level term (e.g., a basic-level term), because children who already knew a familiar superordinate term ("pet") for the otherwise unfamiliar objects still overrode syntactic evidence to make a common noun interpretation of a proper name.

The reliable difference between children's tendency to make a proper name interpretation in the familiar and unfamiliar conditions also provides support for the claim that children expect word meanings to contrast (Clark, 1987). When children knew no name for the kind of object, they tended to interpret the word as referring to a kind of object. When children already knew a name for the kind of object (e.g., "cat"), they sought a different interpretation of a second word learned for such objects, namely a proper name.

Several studies of lexical acquisition have stressed young children's sensitivity to syntactic cues to the meaning of new words (e.g., Brown, 1957; Taylor & Gelman, 1988; Waxman, 1990). This sensitivity is important, and must become increasingly important because it provides valuable semantic information for word learners. However, findings such as these, in addition to those by Markman and Wachtel (1988) and Soja (1990), suggest that there are circumstances under which syntactic evidence may be overruled, specifically, when it conflicts with the object kind bias. Up to what age this bias exerts such a strong influence on the interpretation of new words is still unknown, as is how this bias affects young children's interpretations of new words under more naturalistic circumstances. A commonly-heard anecdote concerns young children who overextend "Daddy" to include men other than their father, apparently treating the word as a common noun rather than as a proper name. Other evidence, however, suggests that young children rarely err in their interpretations of common and proper nouns, as Macnamara (1986) discusses, for example. An interesting, but challenging, question for future research is thus to specify further the conditions under which young children will, and will not, rely on syntactic evidence to interpret new proper names, and other words, correctly.

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Early relations between mother talk and language development: Masked and unmasked

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For some time researchers into language acquisition have been intrigued by the fact that children acquiring language proceed at different rates. Such variation has led researchers to examine possible environmental correlates, with a particular focus on maternal input. The existence of an identifiable register of child directed speech or "motherese" has been well-documented. However, studies aimed at examining the effectiveness of child directed speech (e.g. Newport, Gleitman & Gleitman, 1977; Furrow, Nelson & Benedict, 1979; Scarborough & Wyckoff, 1986) have yielded inconsistent results, and many early proponents of the role of maternal input have since retreated to a "no effects" conclusion (see for example, Shatz & Gelman, 1973 and Shatz, 1982).

Since the early 1970's it has become increasingly obvious that children not only differ in their *rate* of language acquisition, but that there are also differences between children in terms of their *style* or strategy for entering the linguistic system. Bloom's (1970) claim of individual differences between the children in her study received almost immediate supporting evidence from Nelson's (1973) monograph. Referential and expressive children, as Nelson characterized them, differ in the composition of their early vocabularies, with referential children favoring primarily common nouns, while expressive children have vocabularies containing more personal-social words and unanalyzed formulae.

In the present paper we re-examine the status of the "motherese" hypothesis from two different perspectives. First, we document evidence that the hypothesis has not been adequately tested in studies to date. Most studies examining the effectiveness of child directed speech (CDS) have looked at children who were at least 18-months old at the start of the study. In this study we uncover relations between maternal and child language at 13 months - some 5 months before other studies have examined the possible facilitative effects of motherese - and claim that prior studies have been looking for such effects too late.

Further we explore the hypothesis that individual differences in *style* of language acquisition interact with maternal measures to mask the effectiveness of child directed speech. Prior studies of the role of maternal input have not assessed the strategies adopted by the children. It is our contention that it may be impossible to demonstrate consistent effects of child directed speech unless individual differences are taken into account.

Method

Subjects

Forty-five mothers and their children participated in this longitudional study. Mean age at the 13-month visit was 403 days and at the 20-month visit was 619 days. Based on Hollingshead's Index (1975) all children came from middle to upper socioeconomic status households (mean SES = 59.4; range 48 to 66). The sample included 24 females and 21 males, with 36 first-born children.

Descriptive statistics are based on the full sample of 45 children. Thirty-six children, 18 *earlier talkers* and 18 *later talkers* were selected from the overall sample for Study 1. All 45 children were included in the analyses for Study 2, when the sample was dichotomized into a *referential group* ($N = 20$) and an *expressive group* ($N = 25$).

Procedure

At 13 months all 45 subjects were videotaped interacting with their mothers in their

own homes during a 15-minute free-play session. A box of toys and picture books was provided by the experimenter. Mothers were aware that the focus of the study was their child's use of language, and they were asked to interact normally and not to attempt to elicit language from their child. During videotaping the experimenter sat at the child's eye level, on the floor using a hand-held camera. Videotaping commenced once the mother and child had become engaged in the activity itself, and, as far as could be judged, were indifferent to the presence of the camera. All dyads were videotaped again at 20 months for 15-minutes during free-play. (Children were also observed in a meal context at 13 and 20 months, but those data are not included here.)

In addition to the observational data, at the 13-month session mothers were administered a structured questionnaire (Snyder, Bates, and Bretherton, 1981) designed to establish the child's comprehension and production of language. Mothers were informed that no child at 13 months comprehends or produces all of the words in question, and were also provided with concrete examples in which a child's apparent comprehension of a word might be attributed to other factors, such as tone of voice, accompanying gesture or contextual support. When it was clear that the mother understood these points, she was questioned extensively regarding each item, and systematically probed about the context in which any word was comprehended or produced.

Measures

The interview was scored following Snyder et al. (1981), and separate scores for production and comprehension were obtained for the categories of common nouns, proper nouns, and other words and phrases (non-nouns). Maternal interviews were used as the primary source of data to establish each child's 13-month vocabulary, since the range of a child's vocabulary was unlikely to emerge during the videotaped 13-month session. Snyder et al. (1981) have found that mothers can be reliable observers when interviewers ask specific questions and mothers are required to provide examples. All subjects in the group of 18 *earlier talkers* had productive 13-month vocabularies of at least 15 words according to the maternal questionnaire. The 18 *later talkers* had vocabularies of seven words or less at 13 months.

Maternal language measures were assessed from the 13-month videotapes. Maternal referencing behavior was coded following Furrow & Nelson (1984). Each mother's use of nominals was divided into the major categories of nouns and pronouns, and the number and proportion of object and person references were also calculated. All nominals were further subdivided into the categories of object-noun, object-pronoun, person-noun, person-pronoun, abstract-noun and abstract-pronoun, and proportions calculated for each subcategory. The total number of nominals exceeded the combined number of person and object references because of the existence of abstract nouns, and the use of pronouns to refer to events or actions.

In addition, the function of each maternal utterance was coded, using a modified version of Folger and Chapman's (1978) coding scheme. Open-ended questions, such as, "What's that?" (Requests for Information) were coded separately from questions eliciting "yes/no" answers (Requests for Confirmation and Permission).

Study 1

Two groups of children were selected for Study 1 based on the reported size of each child's productive vocabulary. The group of *earlier talkers* was composed of all children producing 15 or more words at 13 months (N=18), while the group of *later talkers* contained all children producing 7 words or less (N=18) Measures of 13-month maternal language were compared for these two groups, and lagged associations to 20-month MLU were examined.

Study 2

The total sample was divided into 2 groups according to the child's 20-month stylistic

preference. Stylistic preference at 20 months was assessed from the child's spontaneous noun-to-total-word ratio. Children with a ratio of 40% or less formed the *expressive group* ($N = 25$), while all children who had a ratio greater than 40% were grouped into the *referential group*. Lagged associations between maternal 13-month measures and child 20-month MLU were examined within each group.

Results

The results are presented in several parts. First, descriptive statistics for the 13-month child and maternal variables are reported. These are followed by descriptive 20-month statistics. The results of Study 1 involve *t-test* comparisons of the mothers of the earlier and later talkers, followed by predictive relations to 20-month MLU for the two groups. Finally, the results of Study 2 present similar lagged associations between 13-month maternal measures and 20-month MLU for the total sample, followed by separate relations within the expressive and referential groups.

Descriptive Statistics for 13-month Child Language

Descriptive statistics for 13-month language comprehension and production as reported by maternal questionnaire are presented in Table 1. It can be seen that, according to maternal report the sample contained children who differed considerably in terms of rate of language acquisition. All children comprehended at least some common nouns, proper nouns and other words, but one child had not yet produced any words, and the child with the largest productive vocabulary had 79 different words in his vocabulary at 13 months. Similarly, it is clear from the range of common nouns shown in Table 1 that the sample provided a range of variation consistent with stylistic differences.

Table 1
Descriptive Statistics for 13-month Child Language Measures (N=45)

	MEAN	S.D.	RANGE
COMPREHENSION			
TOTAL	64	24	23-118
# COMMON NOUNS	28	17	4-69
% COMMON NOUNS	40	12	17-63
% NON-NOUNS	49	10	29-70
PRODUCTION			
TOTAL	19	20	0-79
# COMMON NOUNS	10	13	0-54 †
% COMMON NOUNS	41	23	0-73 †
% NON-NOUNS	34	20	0-100 †

† Range represents children producing $\geq$ 1 word

Descriptive Statistics for 13-month Maternal Language

Descriptive statistics for maternal references are presented in Table 2. On the average, mothers produced about 18 utterances per minute, each containing one nominal reference. The average ratio of pronoun to noun usage was 3:2, with slightly more references to objects than to people. However, a glance at the reported ranges for these variables reveals that such group statistics obscure variation between mothers. Mothers produced as few as 9 or as many as 30 utterances per minute, and some mothers produced twice as many nominals per utterance as others. Mothers also varied considerably in the extent to which they emphasized nouns, objects and persons in their references.

Table 2
Descriptive Statistics for 13-month Maternal References (N = 45)

	NUMBER			PERCENT		
	$\bar{X}$	SD	RANGE	$\bar{X}$	SD	RANGE
UTTERANCES	277	79	134-458			
NOMINALS	328	110	102-665			
NOUN	125	50	35-272	38	7	24-57
PRONOUN	203	73	67-393	62		43-76
OBJECT	149	56	34-298	45	9	30-72
PERSON	118	47	46-250	36	7	21-52
OBJECT NOUN	83	38	22-184	25	8	10-52
PERSON PRON	87	36	38-193	27	6	11-37
OBJECT PRON	65	29	12-133	20	5	10-32
PERSON NOUN	31	17	2-77	9	4	1-21
ABSTR. NOUN	11	8	0-33	3	2	0-8
ABSTR. PRON	51	21	15-99	16	5	6-29

The picture is similar when maternal functions are examined. Table 3 presents descriptive statistics for maternal language functions at 13 months. Again, it is clear that there was considerable variation between mothers. For example, only 2% of one mother's utterances were descriptions, compared with 37% for another mother. While most mothers provided some performative play, (nursery rhymes, peek-a-boo routines, riddles and dramatic phone talk), for one mother this function comprised 21% of her total utterances. Similarly, conversational devices, which are simply a means of maintaining or establishing contact, provided 30% of another mother's utterances. On the average, descriptions and requests for action were the two major functions, totalling approximately 40% of all utterances. However, with such variation within the sample, average measures have very little significance. It should also be remembered that the most talkative mother, (in terms of the number of utterances), provided more than three times as many utterances as the least talkative mother.

Table 3
Descriptive Statistics for 13-month Maternal Functions (N = 45)

	NUMBER			PERCENT		
	$\bar{X}$	SD	RANGE	$\bar{X}$	SD	RANGE
DESCRIPTION	58	25	3-116	21	7	2-37
REQ. INFO.	21	12	0-57	7	4	0-16
PERFORM.	13	10	0-41	5	4	0-21
REFER. REPET.	3	5	0-25	1	2	0-7
STATEMENT	30	22	8-136	10	5	5-32
REQ. PERMISS.	27	12	11-54	10	4	4-19
REQ. ACTION	57	28	14-155	20	7	8-35
CONV. DEVICE	35	16	11-90	13	5	3-30
EXPRESS. REPET.	4	4	0-17	2	1	0-6
SOUNDS	25	14	4-67	9	5	3-22

Descriptive Statistics for 20-month Child Language

Descriptive statistics for 20-month child language measures are presented in Table 4. At 20 months only three children had MLUs of 1.00 or less. Twenty-four children had MLUs between 1.01 and 1.50, falling into Brown's (1973) Early Stage I, and thirteen children fell into Late Stage I (MLU 1.50 to 2.00). An additional five children had MLUs between 2.01 and 2.90. It is clear that there was considerable variation between children both in terms of their rate of language acquisition and in terms of their emphasis upon nouns.

Table 4
Descriptive Statistics for 20-month Child Language Measures (N = 45)

	MEAN	S.D.	RANGE
NOUNS #	37.8	32.3	0-156
NOUNS %	37.7	17.9	0-76%
PRONOUNS #	20.9	18.9	1-74
PRONOUNS %	20.7	15.0	2-49%
OTHER #	45.0	35.0	4-145
OTHER %	43.0	13.8	11-69%
MLU	1.49	.44	.70-2.90
MaxLU	2.76	1.15	1.00-6.00

Study 1

When the mothers of the *earlier* and *later talkers* are compared with *t*-tests several differences are found. First, it should be noted that there were no differences between the two groups in terms of the number of maternal utterances or total number of nominals. However, the *earlier talkers* at 13 months were being exposed to a significantly higher percentage of nouns, object references and object nouns than the *later talkers*, whose mothers provided a higher percentage of abstract references (both nouns and pronouns). There were also significant differences between the two groups of mothers in terms of the functions of their utterances, as Table 5 reveals. Mothers of children with larger vocabularies provided a higher percentage of descriptions and referential repetitions. In contrast, mothers of the later talkers provided more requests for action and conversational devices. The relation between requests for action and slower language acquistion is consistent with several other studies.

Table 5
Comparisons of 13-month Maternal Functions & References for Earlier and Later Talkers

	E.T.	L.T.	t
REFERENCES:			
% NOUN	41	35	2.54*
% OBJECT	49	40	3.25**
% OBJ. NOUN	30	21	3.69**
% ABSTRACT	17	21	- 2.64*
FUNCTIONS:			
% DESCRIPT.	24	17	3.13**
% REF. REPETIT.	2.3	.2	3.77**
# REF. REPETIT.	6.4	.3	3.48**
% REQ. ACTION	17	22	- 2.43*
# REQ. ACTION	42	60	- 2.30*
# CONV. DEVICE	29	40	- 2.04*

* $p < .05$; ** $p < .005$

Selected lagged associations between 13-month maternal references and functions and 20-month MLU for the ***earlier talkers*** and ***later talkers*** are displayed separately in Table 6. It should be noted that there were no significant relations between any of the maternal language variables and the child's level of grammatical advancement at 20 months for the group of ***later talkers***. For the group of ***earlier talkers***, however, there were several relations. Maternal number of object references, object nouns and repetitions of child nouns were all positively related to 20-month MLU, while percentages of person nouns and requests for action were negatively related.

Table 6
Relations between 13-month Maternal Measures and 20-month MLU

	EARLIER (N = 18)	LATER (N = 18)
MEAN MLU	1.75	1.27
	s.d. = .51	s.d. = .28
MATERNAL REFERENCES:		
# OBJECTS	.60**	.19
# OBJECT NOUN	.57**	.13
% PERSON NOUN	-.49*	-.06
FUNCTIONS:		
# REF. REPETIT.	.50*	.19
% REF. REPETIT.	.51*	.19
% REQ. ACTION	-.47*	.36

* $p < .05$; ** $p < .02$

The incidence of referential repetitions raises the issue of whether this should be regarded as an indication of child influence upon maternal language. Mothers of the two groups did differ significantly in terms of number and percent of maternal repetitions of children's nouns. Since ***later talkers*** were producing fewer words, they also produced fewer nouns, and, therefore, provided fewer opportunities for mothers to repeat them. For ***later talkers***, therefore, the failure to find an association between this variable and 20-month MLU may be the result of dealing with a truncated range. However, the relationship between referential repetitions and 20-month MLU for the ***earlier talkers*** cannot be dismissed as merely an artifact. For this group, 20-month MLU was not significantly related to 13-month noun usage. The relations between 13-month maternal referential repetitions and 20-month MLU are unaffected by partialling out the effect of child noun usage at 13-months.

Study 2

Table 7 displays relations between 13-month maternal language measures and 20-month MLU for the total sample of 45 children. While several statistically significant relations were found, it should be noted that the amount of variance explained by these variables is low (between 9% and 36%). Moreover, when multiple regressions are run, (partialling out the effect of the child's vocabulary size at 13-months), only two variables are found to make a significant unique contribution to 20-month MLU, and each makes a very small contribution.

However, the aim of this study was to explore the possibility that individual differences in style of language acquisition play a role in masking the effects of child directed speech. In order to address this question, the sample was divided according to 20-month stylistic preference, and relations between 13-month maternal measures and 20-month MLU were calculated separately for each group. These relations, along with *t*-tests are displayed in Table 8. First, it should be noted that the ***referential*** and ***expressive groups*** do not differ in terms of 20-month MLU. There is also no difference between the two groups for 13-month total vocabulary size, since earlier and later talkers are represented equally in each group.

Table 7

Relations between Maternal 13-month Measures and 20-month MLU (N=45)

MATERNAL	MLU	PARTIAL OUT VOCAB SIZE
REFERENCES:		
NOUNS #	.33*	ns
OBJECT #	.39*	ns
OBJECT %	.45**	ns
PERSON %	-.36*	ns
OBJECT NOUN #	.45**	ns
OBJECT NOUN %	.41*	ns
PERSON NOUN %	-.30*	* (6%)
FUNCTIONS:		
DESCRIPTIONS #	.35*	ns
REQ. FOR INFO. #	.36*	ns
REF. REPETIT. #	.59**	ns
REF. REPETIT. %	.60**	* (7%)
CONV. DEVICE %	-.37*	ns

* $p < .05$; **$p < .005$

From Table 8 it is evident that many relations exist between maternal references and functions and 20-month MLU for the *referential group* which are totally non-existent for the *expressive group*. Maternal number of object nouns, for example, accounts for approximately 50% of the variance in grammatical development between children in the *referential group*. Only one maternal function, referential repetitions, was related to MLU for both groups. However, while number of referential repetitions explains 79% of the variance between children in the *referential group*, the same variable accounts for only 18% for the *expressive group*. Moreover, *t*-tests indicate that for most of these variables (apart from percent of nouns and object nouns), the mothers for these two groups do not differ. Therefore, it would appear that the children in the *referential group* were actually employing a different strategy to acquire language: one which enabled them to take advantage of certain features of maternal language.

Table 8

Differential Maternal Effects on 20-month MLU

	REF. (N = 20)	EXP. (N = 25)	t
MEAN MLU	1.44 s.d.=.52	1.52 s.d.=.36	.62
REFERENCES:			
NOUNS #	.53*	.16	.80
NOUNS %	.49*	.05	2.39*
OBJECT %	.66**	.32	1.49
OBJECT NOUN #	.70**	.24	1.26
OBJECT NOUN %	.64**	.23	2.50*
ABSTRACT %	-.45*	-.09	.92
FUNCTIONS:			
DESCRIPTION #	.44*	.30	1.58
REF. REPETIT. #	.89**	.42*	.34
REF. REPETIT. %	.79**	.49*	.68
CONV. DEVICE #	-.44*	-.05	.16
CONV. DEVICE %	-.54*	-.15	.06

* $p < .05$, ** $p < .005$

Moreover, when the child's own vocabulary size at 13 months is partialled out, the relation to referential repetitions is no longer significant for the *expressive group*. However,

several maternal variables continue to make a significant unique contribution for the *referential group* (% object = 18%; # object nouns = 18%; % object nouns = 13%; # referential repetitions = 39%; % referential repetitions = 27%).

Discussion

The results of Study 1 indicate that the mothers of earlier and later talkers differ themselves at 13-months. The direction of effects cannot be untangled from the present study, but it is possible to conclude that an adequate test of the motherese hypothesis would require data from prior to 13-months. The non-effects found in previous studies with much older children are cast into doubt by the results of the present study. This is particularly the case when it is noticed that children in those studies were more similar to the group of *later talkers* in terms of MLU, while that group was precisely the group for which no relations between maternal language and grammatical development were found. Previous studies therefore may have been looking for the effects of child directed speech too late.

Study 2 reveals that when the sample is dichotomized according to the child's style of language acquisition, maternal variables have different effects depending upon the strategy adopted by the child. Several maternal variables continue to make a significant unique contribution to 20-month MLU for the *referential group* even when the effect of 13-month vocabulary size was statistically removed from the analysis. This we argue is a conservative measure, since 13-month vocabulary size for this group was itself related to several maternal variables. The possibility therefore exists that 13-month maternal language contributed both to 13-month vocabulary size and to 20-month MLU.

Since lagged associations between 13-month maternal measures and 20-month MLU revealed that children adopting referential and expressive strategies make differential use of maternal measures, we argue that, in prior studies, individual differences have masked the effects of child directed speech. Unless researchers take individual differences in style of language acquisition into account it may continue to be difficult to demonstrate consistent CDS effects, which apparently vary depending upon the match between the child's acquisition strategy and the mother's linguistic style.

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Implementations are not Conceptualizations: Revising the Verb Learning Model

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A recent issue of Cognition was devoted to an in-depth criticism of the connectionist agenda. At the focus of much of this criticism was a PDP simulation by Rumelhart and McClelland (1986) of the acquisition of the phonological form of the English past tense. A lengthy article by Pinker and Prince (1988) was devoted entirely to the critique of the R&M verb learning model. A somewhat shorter article by Lachter and Bever (1988) devoted most of its pages to the R&M verb learning model, while also critiquing four other connectionist models in somewhat less detail. The chapter that served as the target of this extensive criticism had as its goal the formulation of an computationally explicit connectionist model of the child's learning of the past tense forms of English verbs. This "verb-learning" model of Rumelhart and McClelland (henceforth R&M) was capable of taking as input a present tense verb, such as "ring," and providing as output a past tense form, such as "rang." It did this without any overt encoding of a set of rules and without any formal construction of morphological paradigms.

The arguments against this model presented by Pinker and Prince (henceforth P&P) and Lachter and Bever (henceforth L&B) were well-constructed and thoughtfully developed, and their critique has generated a great deal of useful discussion. Moreover, there is good reason to agree with many of the detailed aspects of the two critiques. However, these authors are mistaken in thinking that their criticisms call into question the general connectionist conceptualization, rather than merely casting doubt on a particular connectionist implementation. In this regard, it is crucial to note that P&P believed that their analysis was quite profound (p. 82).

> "We will conclude that the claim that parallel distributed processing networks can eliminate the need for rules and for rule induction mechanisms in the explanation of human language is unwarranted. In particular, we argue that the shortcomings are in many cases due to central features of connectionist ideology and irremediable; or if remediable, only by copying tenets of the maligned symbolic theory. The implications for the promise of connectionism in explicating language are, we think, profound."

L&B also believed that they had isolated a fundamental weakness in all connectionist approaches to language learning (p. 243).

> "The connectionist models we have considered arrive at rule-like regularities in language behavior only insofar as the models already contain architectures and devices explained in humans by mental representations of categorical rules."

In this paper, we will consider whether these analyses are as profound as their authors claimed them to be.

1. The Criticisms

P&P and L&B argued that claims made by R&M regarding the success of the verb learning model are extremely misleading. They expressed their respective cases against the verb learning model in terms of a set of points. P&P (p. 81) presented at least ten specific problems which they believed were incorrectly addressed by the R&M model. These problems are repeated below in quotation marks. Numbers and problem names have been added for ease of reference.

1. **The u-shaped learning problem:** "Rumelhart and McClelland's actual explanation of children's stages of regularization of the past tense morpheme is demonstrably incorrect."
2. **The "ated" problem:** "Their explanation for one striking type of childhood speech error is also incorrect."
3. **The "hit-hit" problem:** "Their other apparent successes in accounting for developmental phenomena either have nothing to do with the model's parallel distributed processing architecture, and can easily be duplicated by symbolic models, or involve major confounds and hence do not provide clear support for the model."
4. **The "algalgal" problem:** "The model is incapable of representing certain kinds of words."
5. **The "slit-silt" problem:** "It is incapable of explaining patterns of psychological similarity among words."
6. **The "brag-grab" problem:** "It easily models many kinds of rules that are not found in any human language.
7. **The phonological regularities problem:** "It fails to capture central generalizations about English sound patterns. It makes false predictions about derivational morphology, compounding and novel words."
8. **The homophony problem:** "It cannot handle the elementary problem of homophony."
9. **The convergence problem:** "It makes errors in computing the past tense forms of a large percentage of the words it is tested on."
10. **The regular pattern problem**: "It makes incorrect predictions about the reality of the distinction between regular rules and exceptions in children and in languages."

Problems 1, 4, 5, 7, and 10 were also raised by L&B. In addition, L&B provided a second form of criticism that is quite different from that developed by P&P. L&B claimed that the R&M verb learning model achieved much of its success by using a variety of TRICS (The Representations It Crucially Supposes). They believed that, together, these TRICS led to a cryptoembodiment of rules with the connectionist net. These TRICS all relate to the design and interpretation of the Wickelfeatures in the verb learning model. L&B complained that the selection of 460 particular Wickelfeatures from a possible set of about 2000 involved a variety of decisions that tended to reconstitute traditional segmental phonemic information. L&B used this observation to argue that connectionist architectures necessarily contain cryptoembodiments of rules.

11. **The cryptorule problem**: The selective development of an input representation can lead to the cryptoembodiment of rules in PDP nets.

There are two additional problems with the R&M verb learning model that were not raised by either P&P and L&B.

12. **The early noise problem**: In the R&M model, many epochs of training were required before the model would output phonological forms close to those of recognizable words. There is indeed an early period in child phonology when words have a very indistinct shape. However, when children are working out the various forms of the verb, most of these phonological limitations have been overcome. To be sure, early past tenses include many overregularizations and mismarkings, but these errors are typically modifications of the basic form of the verb, rather than phonologically inarticulate forms.

13. **The direct access problem:** The R&M model works by converting one phonological representation into another phonological representation. This mode of access takes a "basic" form and uses it to find a "derived" form. This is certainly one of the ways in which we can access the correct past tense of a verb. However, we can also access words directly through meaning. It is not yet clear how connectionist models can simulate direct access in a theoretically interesting way.

2. The new simulation

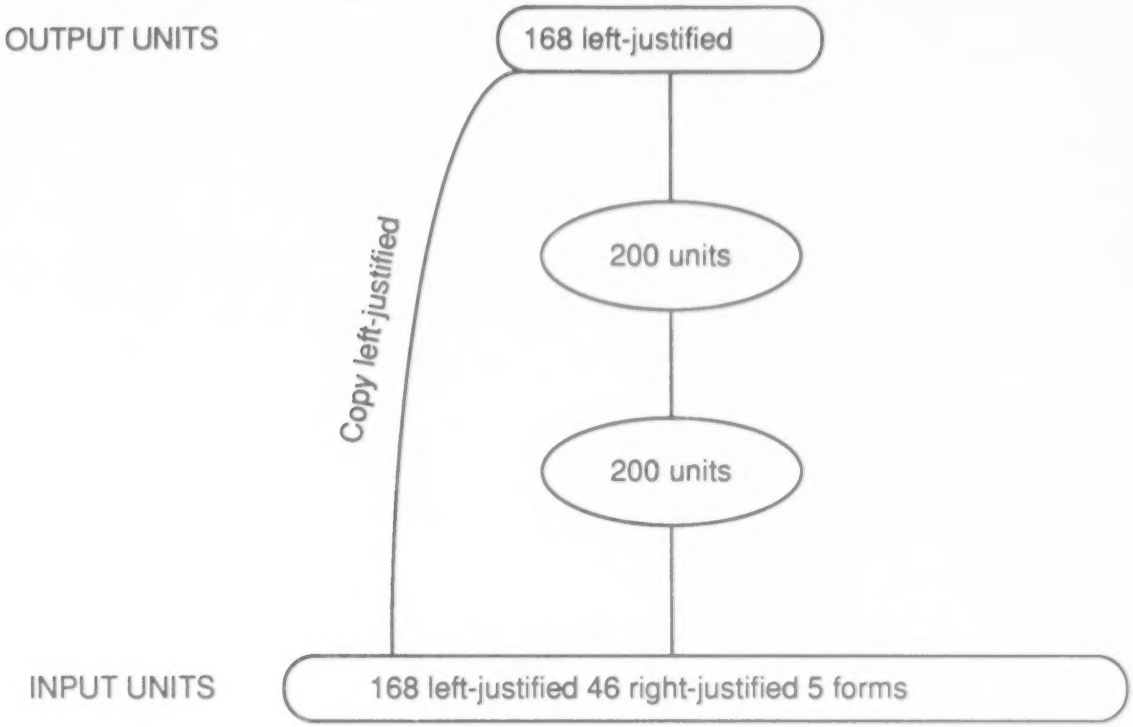
The new simulation uses a new input representation, a new output representation, a new network architecture, a new learning algorithm, and a new input corpus. Each word is represented by a trisyllabic left-justified pattern and a monosyllabic coda in a right-justified pattern. The trisyllabic pattern takes the form CCCVVCCCVVCCCVVCCC, where C stands for consonant and V stands for vowel. The coda pattern takes the form VVCCC. The way in which sounds are filled into these slots is explained below. Vowel nuclei are composed of up to two segments and consonantal clusters are composed of up to three segments. If a particular segment is not actually present in a word, its features are simply left off.

The 14 vowels of English are represented by eight distinctive features. Since there are six possible vowel slots, there are a total of 48 units dedicated to vowels. The 22 consonants of English are represented by ten distinctive features. Since there are twelve possible consonantal slots, there are a total of 120 units dedicated to consonants. Together, the 120 consonantal units and the 48 vocalic units yield a combination of 168 feature/slot units for the left-justified representation and another 46 feature/slot units for the right-justified coda for each input word. The input also includes five units dedicated to the five cells in the paradigm for English verbs. There is one unit each for the present, the past, the past participle, the present participle, and the third person singular present.

The output of the network is simply the 168 feature/slot units of the left-justified phonological form. Between the input and output units there are two pools of 200 "hidden" units. These units are called "hidden" because they have no direct interpretation in either input or output terms. Between adjacent pools, every unit of one pool is

connected to every unit of the other pool. The model uses two pools of hidden units, because a model which had only one pool of units did not do as well at learning the training set.

The final feature of the network is a set of identity-mapping connections between the left-justified input and the output. The network was designed to treat the learning of the "derived" forms of the verb as modifications of the phonological form of the "basic" present tense. The idea is that the child assumes that the past tense is somehow a modification of the present. This is done by including a set of connections that "copy" the left-justified phonological form of the input directly onto the output. This copying only sets a weak bias on the activation of the output units. This bias can be overcome with learning. Indeed, as we will see, the initial bias is usually overcome within a few trials.



2.4. The learning procedure.

A major difference between the current model and the R&M model is that the new simulation uses the back-propagation learning algorithm (Rumelhart, Hinton, & Williams, 1986a). This algorithm makes use of pools of hidden units to capture nonlinearities in problem spaces. The improved learning of the training set found in the new simulation is at least partly attributable to this more powerful learning algorithm.

Training consisted of 24,000 runs or epochs, during which the network was trained to produce the correct output for various forms. Forms were presented with the actual relative frequencies found in (Francis, & Kucera, 1982), with the most frequent form being produced exactly once per epoch, and the rarest forms about once every 700 epochs. This resulted in the presentation of about 1.3 million forms during the course of training.

The input corpus was derived from the Francis and Kucera (1982) corpus of English word frequencies. The 6949 most frequent verb forms - including present, past, past participle, present participle and third person singular - were first selected as a base set for the simulation. These were derived from 2161 different verbs. Homophones and multiple forms (e.g. past tense for "spit" can be either "spit" or "spat") were eliminated by extracting the less common forms. All forms which had more than three syllables, more than three consonantal phonemes in a row, or more than two vocalic phonemes in a row were also removed. The remaining 6090 forms, derived from 2062 verbs, represented the corpus of forms used in the simulation. Of these the least frequent 10% of the regulars and the least frequent 10% of the irregulars were extracted and saved for testing the generalization abilities of the network. The remaining 5481 forms were used for training. The training set included 118 irregular past tense forms.

3. The Results

The most relevant results are those for the past tense. First, let us consider some general aspects of the irregular past tense results.

1. Typically, the present tense was produced as output during the first 40 to 80 epochs.
2. For zero-marking irregulars such as "cut" or "hit," the period of direct reproduction extended as far as epoch 200 before the first attempts were made to produce overregularizations such as "cutted" or "hitted."
3. For forms with vowel changes, the network spent a period from about epoch 200 to about epoch 3000 exploring alternative vowel shifts and modifications.
4. Concurrently with explorations of vowel shifts, the network explored use of final /t/, /d/, and /Id/.
5. For most of the forms, correct performance was stabilizing by epoch 3000. However, a few late vowel errors and overuses of final /t/, /d/, or /Id/ can be found up to around epoch 6000.
6. In most cases, the last 10,000 epochs are error free.
7. There were three forms that were only learned in the last 10,000 epochs. These were "bled" at 14780, "brought" at 15810 and "thought" at 15820.
8. Only eleven low frequency irregular forms remained unlearned at the end of training.
9. In the testing done at the end of the simulation, nine of the thirteen *untrained* past tense irregulars were missed. Six of these were simply mistaken as other classes of irregulars or as regulars, as the network had no way to know for sure to which class they belonged.

By the first test point the regular past tense was already over 99% correct. In overall terms, the simulation obviously did very well at its task of learning the past tense. These results

are encouraging, but how well was the model able to address the 13 specific problems we examined earlier?

3.1. The u-shaped learning problem

The u-shaped learning for verbs involves four observable components -- early correct usage, subsequent overregularization, coexistence of correct and incorrect forms, and final correct usage. The new simulation correctly models the last three components.

1. **Overregularization.** Usually, overregularization begins shortly after the first 50 or 100 epochs. For nearly every one of the irregular verbs, except for zero-marked pasts such as "hit" or "cut," there is a clear early period of overregularization. This is not an across-the-board phenomenon, since some verbs show much more overregularization than others and some show it for a much longer period than others.
2. **Coexistence of correct and incorrect forms.** There is then a period of between 300 and 3000 epochs for almost all irregular verbs where the correct form coexists with overregularized forms. For a verb like "bent" this period ends by epoch 2800; for a verb like "arise" it extends to epoch 8010.
3. **Final correct usage.** For nearly all of the verbs, there then follows a long period of final correct usage. It is important to note that, once the network reaches correct performance, deviations from the correct model are fairly infrequent. There are indeed late occurring errors against a background of correct performance, such as the uses of "binded" for "bound" on epochs 1950 and 2300. However, when we realize that the learning went on for 24000 epochs, it is clear that much of this period was spent in error-free performance for this verb. In this sense, the model behaves fairly deterministically, reflecting the deterministic nature of the learning algorithm. If we were interested in simulating adult speech errors, we would have had to employ a non-deterministic model.

However, the simulation fails to capture the fourth component of the u-shaped pattern -- early correct usage for irregular forms.

3.2. The "ated" problem

P&P argue that forms such as "ated" arise when the child confuses "ate" with the present. Capturing this type of processing in this network was extremely easy. We simply constructed a second set for testing generalization that was composed of four irregular past forms. The verbs were "ate," "broke," "ran," and "bought." The results are not particularly surprising. The network produced as output the forms "ated," "broked," "ranned," and "boughted." This was the case for "ate," "ran," and "brought" at the first test point (epoch 4000). "Broke," however, yielded "broke" as its past tense in this particular type of generalization testing until the test at 12000 epochs, after which point it produced "broked."

3.3. The "hitted" problem

Like the R&M model, the new simulation produced fewer overregularizations for zero-marking verb like "cut" and "hit" than for other irregulars. Indeed the zero-marking class was learned quite quickly with very few errors. For example, "burst" had only three "bursted" errors, and only seven errors in total. The verb "cast" had only one "casted" error after epoch 1950; "cost" had none after epoch 1340, and "cost" had none after epoch 210. Perhaps the most dramatic evidence for the power of what Menn and MacWhinney (1984) called the "repeated morpheme constraint" is in the verb "cut" which had only three errors in 24000 epochs -- two of which were uses of the overregularized "cutted" on trials 170 and 210. When we compare this virtually error-free learning of "cut" with the difficulties the network had in learning an alternation such as "deal - dealt," it is clear that verbs of the "hit" and "cut" type are much easier to learn than other irregulars.

3.4. The "algalgal" problem

The "algalgal" problem disappears in the new simulation. The phonological representation used in the new simulation guarantees unique representations for different sounding words. The left-justified representation of Oykangand "algal" is CCCaVlgCaVlCCVVCCC, whereas that of "algalgal" is CCCaVlgCaVlgCaVlCC. Since these different words have different representations, it is clear that the "algalgal" problem is solved by the new simulation.

3.5. The "slit-silt" problem

The "slit-silt" problem also disappears with the new simulation, because phonologically similar words now have more similar representations. In the case of "slit" and "silt" the /i/ appears in exactly the same slots for both words. The final /t/ also appears in the same slot in the right-justified representation.

3.6. The "brag-grab" problem

We ran an auxiliary simulation identical to the basic simulation, but in which the past tense was formed simply by reversing the order of segments in the present tense. For example, the past tense of "brag" was "grab" and the past tense of "trickle" was "lkirt." This transformation greatly impaired the performance of the network on the past tense. After 24000 epochs of training, only 15% of the forms were correct. Apparently, the network cannot learn an alternation of this type.

3.7. The phonological regularities problem

The new simulation addresses the phonological regularities problem in a variety of ways. First, the change to a feature/slot representation improves its ability to model generalization across the phonological inventory. To demonstrate this, the simulation was also given the verb "bach" /bax/ as a generalization test and correctly produced the past tense form "bached" /baxt/. Second, by including multiple forms of each verb in training, the simulation was able to demonstrate cross-paradigm regularities. For example, the progressive of "accompanying" was occasionally formed as "accompanyng." The deletion of the initial /I/ of the progressive -ing suffix appears to be a result of paradigmatic pressure

from similar deletion patterns occurring in the other suffixes. Of course, the network learns to counteract this pressure, but the important fact is that the new simulation shows the presence of such phonological regularities. Other evidence of the impact of phonological regularities is provided by interpenetrations of past participle forms into irregular pasts.

3.8. The homophony problem

A small auxiliary simulation was run to demonstrate the ability of the network to acquire past tense forms for homophones. The verbs used were "ring," "wring," "jump," "want," and "run." The network architecture was supplemented by the following 21 semantic features: action, auditory-result, cause-contact, circle, completive, high-pitch, internal-state, object-gap, object-state, object-thing, positional-change, response, sharp-onset, speech-act, surround, torque, use-of-hands, use-of-feet, vertical direction, volitional, and whole-body-motion. The results of this simulation were quite simple. The network learned to produce "rang" as the past tense of "ring-1," "ringed" as the past tense of "ring-2," and "wrung" as the past tense of "wring" within 2400 epochs. These results indicate that nets of this type can readily resolve homophony.

3.9. The convergence problem

By epoch 4000, all but seven of the regular past tense forms were being produced correctly. By epoch 8000, all but one of the regular past tense forms were correct. By epoch 16,000, all of the regular past tense forms were correct. By the end of training at epoch 24,000, errors were being made on only 11 of the irrregular pasts. Perfect performance on the present progressive was achieved by the first check at 4000 epochs. The third person singular present was perfected by the end of the simulation. Learning of the past participle followed a pattern similar to that for the past. It is clear that the network succeeded at its assigned task of learning the English verb paradigm. If we had allowed the network to run for several additional days or given it additional hidden unit resources, we probably could have reached complete convergence.

3.10. The regular pattern problem

Regular pasts were learned fairly early and without significant error. By the first check at epoch 4000, only seven of the 1059 reguar pasts were being missed. This dropped to one miss by the following check at epoch 8000, and by epoch 16000 performance was perfect. This type of learning is exactly what we see in children.

P&P suggest that, in some way, connectionist models are misportraying the role of the regular pattern. Before this issue can be seriously examined, P&P will have to show how this issue can have real consequences for computational simulations. For the moment all we can say is that the results of the new simulation for the regular pattern look just like what we see in real children.

3.11. The cryptorule problem

L&B criticized R&M for biases in the selection and construction of Wickelphones. In general, these complaints were reasonable. However, L&B attempted to move from these reasonable complaints to the general claim that acceptance of a particular featural representation in a PDP network is tantamount to acceptance of a production system architecture. There is no reason to accept this linkage, particularly in regard to the current simulation. More specifically, there is nothing in the featural representation of the current simulation that biases it toward the acquisition of some particular rule. Instead, the representation was chosen to be powerful enough to facilitate learning of different types of rules in different languages. It is true that the representation is capable of expressing something like "final t." However, there is nothing wrong with that ability and nothing that can be construed as involving either TRICS or "tricks."

3.12. The early noise problem

The new simulation no longer spends its initial epochs gropping toward the ability to produce some recognizable form of the verb. From the first trials, it is producing either the present tense or some variant of the present tense. In this regard the model provides a more accurate characterizaiton of the way in which the two-year-old child works on this task.

3.13. The direct access problem

The new simulation does not solve the direct access problem.

4. Is there a better symbolic model?

If there were some other approach that provided an even more accurate characterization of the learning process, we might still be forced to reject the connectionist approach, despite its successes. The proper way of debating conceptualizations is by contrasting competitive implementations. To do this in the present case, we would need a symbolist implementation that can be contrasted with the current connectionist implementation. P&P sketch out a piece of such an alternative but advise the reader not to take it as a "serious model." Unfortunately, the reader has no alternative but to take it seriously. It turns out that the model which P&P are proposing as the main symbolist alternative to the R&M model is fragment of the model of MacWhinney (1978). We are not arguing that the MacWhinney model was ill-constructed and descriptively inadequate. But when it comes to actually implementing the account of MacWhinney (1978), a myriad of detailed decisions must be made regarding the shape of possible input forms, the ways in which rule strengths should be incremented, the algorithm for production matching and conflict resolution, and so on. The current approach avoids these ad hoc modelling decisions.

5. Summary

We have examined a series of 13 problems raised by Pinker and Prince (1988) and Lachter and Bever (1988) against the verb learning model of Rumelhart and McClelland (1986). These problems were presented as fundamental flaws in the conceptualizations underlying connectionism that could well call into question any application of connectionist models to

language processing or learning. To address these problems, we constructed a new simulation using a new input representation based on feature/slot units and two views on input words, a new architecture using identity mappings and hidden units, a new learning algorithm, and an input corpus that included all five cells of the English verb paradigm Together, these changes led to a vast improvement in the performance of the model. All of the 13 problems were addressed successfully except for those dealing with the problem of direct access within connectionist nets.

As a result of this work we conclude that connectionist models are indeed extremely useful ways of characterizing the learning inflectional systems. We also conclude that the critiques of Pinker and Prince and Lachter and Bever erred in confusing conceptualizations with implementations.

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The Acquisition of V^0 Movement*

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The hallmark of Government and Binding Theory (Chomsky, 1981) has been its search for grammatical generalizations. The most spectacular of these generalizations is the rule Move α. This rule eliminates the myriad transformational rules that complicated life for the so-called Standard Theory of transformational grammar. In their place, GB substitutes 1 rule--Move α, which simply says 'move anything anywhere.' To prevent chaos from breaking out, GB Theory also includes a set of constraints on phrase structures, which insure that ill-formed derivations are eliminated.

Mark Baker has proposed making the Move α rule even more general. Everyone else had assumed that the Move α rule only applied to whole phrases--as in Wh-questions. Baker pointed out that in noun-incorporation structures only the head of a noun phrase might be moved to (or incorporated into) the verb. This operation can leave the rest of the noun phrase stranded in its original position. Baker extended this idea by proposing that the head of any phrase may be moved (by an extension of the Move α rule) to become incorporated into the head of any phrase which properly governs the phrase where the incorporating head originated. This is a sweeping proposal and one which presents interesting implications for language acquisition. In this paper, I will focus on some of the theory's implications regarding the acquisition of verb, or V^0, movement.

The tree structure in (1) provides an example of how Baker's hypothesis would apply to causative constructions. Many languages derive causativized verbs by adding a causative affix to a regular verb. Baker assumes that such constructions originate as bi-clausal d-structures in which the causative affix serves as the main verb in the main clause. He bases this proposal on his Uniformity of Theta Assignment Hypothesis, which states, 'Identical thematic relationships between items are represented by identical structural relationships between those items at the level of D-structure' (46). Baker assumes that the causative affix is thematically equivalent to an abstract

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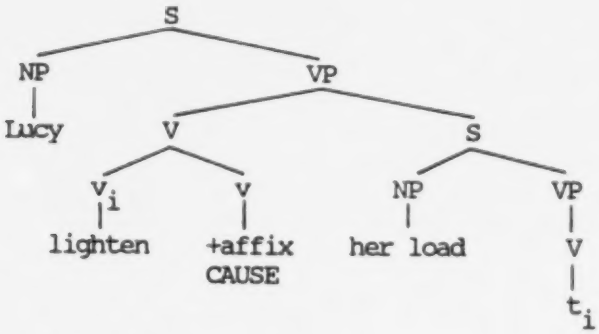
verb CAUSE which assigns both agent and object theme roles. Then Move α may apply to the verb in the lower clause and adjoin it to the verb (the causative affix) in the main clause. If this movement did not take place, the causative affix would be left stranded. This would violate the Stray Affix Filter. Although this filter might appear to be just a gimmick to patch up Baker's version of Move , but it applies to all affixes--not just the causative.

(1) Simplified Causative S-structure



Lucy lightened her load.

I have simplified this example to provide a clearer idea how the basic process works. Many languages, like English, do not allow the causative to apply to transitive verbs. Baker claims this is because the resulting sentences would violate the Case Frame Preservation Principle, which states, 'A complex X^0 (head) of category A in a given language can have at most the maximal Case assigning properties allowed to a morphologically simple item of category A in that language' (122). This principle captures another generalization that seems to hold across languages. If the language permits verbs to have double object NPs, then it is also possible to causativize transitive verbs. Since the causative affix is a verb according to Baker's hypothesis, the resulting complex verb cannot take more NPs than an ordinary, noncausativized verb. English would be a prime candidate for such a process since it contains dative constructions like:

(2) Rose would not give Mortimer the time of day.

I will used longitudinal data that I collected for 4 children acquiring the Mayan language K'iche' to test Baker's theory. A general summary of the language samples for three of the children appears in Table 1. I am in the process of putting this data into the computer, which has allowed me to analyze data from the older siblings of my primary subjects. I have included data from Al Se'p, Al Tiya:n's older sister. Al Se'p was approximately Al Cha:y's age.

Table 1. Ages, number of utterances and MLUs across the K'iche' language samples.

	Al Tiya:n			Al Cha:y			A Carlos		
Samples	age	number	MLU	age	number	MLU	age	number	MLU
1-3	2;1.17	732	1.2	2;9.8	945	1.6	3;1.5	735	1.8
4-6	2;2.6	1069	1.4	2;10.6	1348	2.1	3;1.25	963	2.4
7-9	2;3.19	1155	1.8	2;10.27	1160	2.2	3;4.2	1760	2.8
10-12	2;7.21	844	2.1	3;0.16	1197	2.7	3;4.23	1272	2.8
13-15	2;10.5	1026	2.8	3;1.5	1159	2.7	3;6.26	1333	3.1
16-18				3;2.28	1103	3.0	3;8.5	1508	3.3
19-21				3;4.10	794	3.2			

The sentence in (3) provides an example of the causative construction in K'iche'. K'iche' adds the causative suffix -isa to many intransitive verb stems to produce causativized verbs. K'iche' lacks a double object construction, and as Baker predicts, the use of the causative affix on transitive verb stems is unacceptable. The causative is a highly productive construction in K'iche', but there are a number of intransitive verb stems which do not take it. These lexical exceptions include the verbs pe:t 'come', b'e: 'go', and ul 'arrive here'.

(3) x-Ø-r-oq'-isa-j u-lo:ch' le: ixoq
COMP-3A-3E-cry-CAUSE-DER her-baby the woman

'The woman cried over her baby.'

K'iche' lacks a double object construction, and as Baker predicts, the use of the causative affix on transitive verbs produces ill-formed constructions in K'iche'. The causative can be used with a wide variety of intransitive verbs, although there are lexical exceptions.

I provide the K'iche' causative data in Table 2. There is no evidence that either Al Tiya:n or Al Se'p had acquired the causative since they produced so few examples. I think the fact that they also produced these examples in their later language samples is consistent with a late acquisition for the causative. On the basis of their data, I conclude that K'iche' children begin using the causative around 2;10. For comparison, Al Tiya:n began producing the passive at 2;3.

Table 2. Causative Constructions in the K'iche' data

	Language Sample	Types	Tokens
Al Tiya:n	15	1	1
Al Se'p	12	1	1
	15	1	1
Al Cha:y	1	1	1
	6	2	3
	7	1	1
	12	2	2
	13	1	2
	17	1	1
	18	3	3
	19	2	2
	22	1	1
	24	1	1
A Carlos	7	1	1
	12	2	3
	15	1	1
	18	1	3

The older children, Al Cha:y and A Carlos, show better evidence of having acquired the causative. Al Cha:y's first production was a rather hesitant, syllable by syllable imitation of her older sister--a classic example of what Braine (1976) refers to as a 'groping pattern'. Thereafter Al Cha:y produced 15 tokens of the causative on 7 different verb stems. A Carlos produced 8 tokens on 5 different verb stems.

The children also used the plain counterparts of the causativized verbs at this time. Al Tiya:n used the plain intransitive stem b'in 'travel' 5 times. Al Cha:y used the plain intransitive verb aq'an 'climb' once, kam 'die' 18 times, paqal 'high' 3 times, and the verb walij 'rise' 4 times. She also used plain transitive verb counterparts for the stems chup 'extinguish' and get 'cut'. These verbs have a zero derivation that derives transitive verb stems from intransitive verbs in addition to the causative derivation. A Carlos used the intransitive verb stems b'in 'travel' 14 times, k'at 'shine' 2 times, and ok 'enter' 24 times.

I believe the frequency of the causative constructions as well as the use of intransitive and plain transitive counterparts to the causativized verbs shows that Al Cha:y and A Carlos had generalized the notion of adding the causative suffix to any intransitive verb. They did not overgeneralize the causative suffix to any intransitive verbs where its use would be unacceptable to adults, nor did they use the causative affix with any transitive verbs. Thus, by 2;10 K'iche' children seem to have acquired one construction involving V^0 movement.

I wanted to know whether the children had acquired a more general principle of V^0 movement. K'iche' contains a verb incorporation construction shown in (4).

(4) k-in-e-ka'y-a
INCOMP-1A-GO-look-DEP

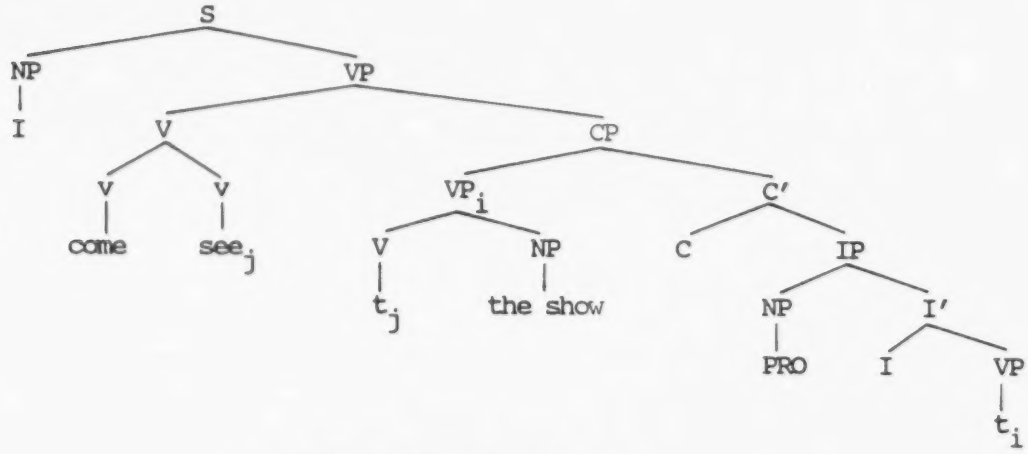
'I will go look.'

k-at-ul-inw-il-a
INCOMP-2A-COME-1E-see-DEP

'I will come see you.'

K'iche' allows reduced forms of three verbs of motion (b'e: 'go', ul 'arrive here', and ikow 'pass') to incorporate into transitive and intransitive verb stems. This would appear to violate the Case Frame Preservation Principle, but note that the subject of the incorporated motion verb is identical to the subject of the verb in the lower clause. This is shown in the following tree structure which uses PRO to identify the subject of the lower clause.

(6) S-structure for verb incorporation



I'll come see the show.

This structure demonstrates another way of incorporating verbs. Here, the entire VP first moves to the complementizer position. Then the verb continues by itself to adjoin with the motion verb, stranding the object NP ('the show') in COMP. I have used this process to demonstrate the flexibility of Baker's theory rather than to claim that verb incorporation uses a different derivational process than the

causative. Baker discusses the differences between these derivations and their implications for the structure of adult languages.

In K'iche', verb incorporation also changes the termination suffix on the verb to the so called 'dependent suffix'. This suffix is used when the verb is in the imperative or when the verb contains an incorporated motion verb. K'iche' children often produced only the final part of the verb, including the dependent suffix. I have relied on my assistants' interpretation of the children's utterances in these cases, as well as noting that an imperative interpretation is much more likely with second person subjects than with first or third person subjects.

If the children had acquired a general rule of V^0 movement, I would expect them to apply it to both the causative and verb incorporation constructions simultaneously. I provide their data on verb incorporation in Table 3.

Table 3. Incorporated motion constructions in the K'iche' data

	Language Sample	Types	Tokens
Al Tiya:n	14	1	1
	15	1	1
Al Se'p	6	2	2
	13	1	1
	14	1	2
	15	2	2
Al Cha:y	5	1	2
	6	1	1
	7	1	2
	8	1	1
	9	1	2
A Carlos	5	1	1
	6	1	1
	8	1	1
	9	1	1
	16	1	1
	18	1	1
	20	1	1

Al Tiya:n lags behind the other children on this construction. The two examples she produced are from her last samples. Her sister, Al Se'p, has produced quite a range of verb incorporation constructions, as have A Carlos and Al Cha:y.

How did the children do on verb incorporation in comparison to the causative construction? Al Tiya:n's data matches perfectly and A Carlos' data is not far off. Al Se'p has one early use of the verb incorporation construction, but I may have missed recording any of her causative constructions by chance. More interesting is the children's

use of verb incorporation with transitive verbs. They had not overgeneralized the causative morpheme to transitive verbs, so they seem to be sensitive to the constraints on the use of both the causative and verb incorporation. This data seems to support Baker's incorporation account fairly well.

There is one other test of the theory that I carried out with the K'iche' data. The verb incorporation constructions that I have discussed so far involve moving a verb from a lower clause into a higher clause. Verb incorporation requires complex underlying structures, and this would imply that children would have to possess the ability to produce complex sentences before they could produce verb incorporation structures. With this test in mind, I extracted the children's complex sentences. This data is shown in Table 4.

Table 4. Complex Sentences in the K'iche' data

	Language Sample	Types	Tokens
Al Tiya:n	7	1	1
	11	1	1
	15	1	1
Al Se'p	1	1	1
	6	2	2
	7	1	1
	11	1	1
	12	1	1
	13	2	2
	14	1	1
	15	1	1
Al Cha:y	1	1	1
	2	1	1
	5	1	1
	7	1	1
	8	2	2
	10	1	1
	12	6	6
A Carlos	7	3	3
	9	1	1
	10	1	1
	13	2	2
	14	1	1
	15	1	1
	17	3	3
	18	4	4
	20	1	1

This data is complicated by the fact that K'iche' input to the children contains frequent use of a 'he/she says X' routine. These

routines add the verb cha 'say' at the end of the sentence. K'iche' children begin using these forms very early. I have only included the children's first use of cha utterances in Table 4. Counting these utterances as complex sentences would support Baker's theory in a trivial way. However, the children might have simply added cha as part of an unanalyzed routine and not have constructed true complex sentences. For this reason, I felt a more conservative test was in order. Therefore, I extracted more traditional examples of complex sentences from the children's data. These make up the remainder of the utterances shown in Table 4. Only the 2 verb incorporation examples from A Carlos contradict this more conservative test of Baker's Incorporation Theory.

I am pushing the K'iche' data to the limit in using it to test Incorporation Theory. At this time it can only provide a tentative confirmation for Baker's theory. There are many more details of the incorporation process that can be turned into predictions about language acquisition. Baker notes that the causativization of transitive verbs is a highly marked process. This would imply that children might only use the causative with intransitive verbs when acquiring languages that allow the causativization of transitive verbs. The causativization of transitive verbs should also occur after the children have used double object NP constructions. The causative construction also requires the use of verb traces, so children's data might be examined for other evidence of their use of traces. Finally, the verb incorporation constructions use PRO, so children's data might be examined for other evidence that they are aware of the constraints that apply to control structures.

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SEMANTIC INFERENCES: THE ROLE OF COUNT/MASS SYNTAX

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Since the meaning of a word that has been ostensively defined is radically underdetermined by the environment, children must have constraints that guide their acquisition of word meanings (Goodman, 1983; Quine, 1969; for a few examples of constraints see Clark 1987; Hall and Waxman, in press; Markman, 1989). Soja, Carey, and Spelke (1990) have suggested that the constraints children use are sensitive to the ontological category of the referent. Specifically, they argued that the constraints depend on whether the referent is an object or a non-solid substance (e.g., mud and sand). They proposed two procedures that embody this claim:

Procedure 1 — Step 1: Test to see if the speaker could be talking about a solid object; if yes,

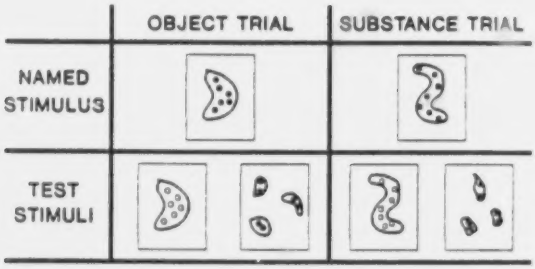
Step 2: Conclude the word refers to individual whole objects of the same type as the referent.

Procedure 2 — Step 1: Test to see if the speaker could be talking about a non-solid substance; if yes,

Step 2: Conclude the word refers to portions of substance of the same type as the referent.

Soja et al. ran two experiments which each had a condition, the neutral syntax condition, that tested these procedures. In this condition 2-year-olds were taught a new word with reference to either an object or a non-solid substance (See Figure 1). Then they were asked to select another referent of the new word given two choices. On the object trials, one choice was an object of the same kind as the original, but made out of a different material. The other choice was three small pieces of the original material. On the substance trials one choice was a new substance in the same shape as the original. The other choice was three small piles of the original substance.

Figure 1
Method in Soja, et al.



The results of this condition support Procedures 1 and 2. On the object trials the subjects chose the object of the original object kind, ignoring the mismatch in material. In contrast, on the substance trials they chose the substance of the original substance kind, ignoring the mismatch in shape and number of piles.

This distinction in ontological kind is related to the count/mass distinction in syntax. Count nouns are quantified over individuals (e.g., "a cup" and "three cups"); mass nouns are quantified over portions (e.g., "one pile of mud" and "three piles of mud"). The count/mass distinction could interact with Procedures 1 and 2 in two different ways. First, Quine (1969) has argued that children learn to make the count/mass distinction, and through that they learn to make the ontological distinction between objects and substances.[1] Second, it could be that children use the subcategorization of a new noun, as well as Procedures 1 and 2, to determine the meaning of the word. In fact, there is evidence that young children can use the syntactic properties of new words to determine the meanings of those words in certain circumstances (Brown, 1957; Gelman and Taylor, 1984; Hall, 1990; Katz, Baker, and Macnamara, 1974; Naigles, in press).

In Soja et al. (1990), in the neutral syntax condition, the subjects' command of count/mass syntax was assessed through their spontaneous productions. There was no correlation between the subjects' control of count/mass syntax and their ability to differentiate the object trials from the substance trials even though many of the subjects had no control of count/mass syntax. These results suggest that children can use Procedures 1 and 2 even before they can use count/mass syntax.

However, the subjects' production skills may not be the best measure of their representation of count/mass syntax. Furthermore, the production result does not address the second possible role for count/mass syntax --that children use the subcategorization of a new noun as a cue to its meaning. Consequently, two different conditions were run: the matching syntax condition, which was reported in Soja et al.,[2] and the conflicting syntax condition, which is new. In the matching syntax condition the objects were labelled with count nouns and the substances were labelled with mass nouns. The syntax matched the ontological kind of the referent. Therefore, if 2-year-olds are sensitive to the relationship between count/mass syntax and the object/substance distinction, the subjects should have been even more likely to choose the object of the original object kind on the object trials and the substance of the original substance kind on the substance trials. That is, they should have differentiated the two kinds of trials even more than in the neutral syntax condition. In the

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1. Different languages may have different means of making a syntactic distinction of quantification. However, Quine must argue that people would not be able to make the object/substance distinction if their language has no syntactic devices for differentiating quantification by individuals from quantification by portions.

2. In Soja et al. the matching syntax condition was called the "informative syntax condition".

conflicting syntax condition the objects were labelled with mass nouns and the substances were labelled with count nouns. The syntax and ontology conflicted. That is, in the object trials, the ontology supported an object response, but the syntax supported a substance response. In the substance trials, the ontology supported a substance response, but the syntax supported an object response.[3] Therefore, since the cues gave conflicting information, if 2-year-olds are sensitive to the relationship between the syntax and the ontology, the subjects should have shown less of a differentiation between the two kinds of trials. Since the results of the conflicting condition have to be compared with the results of the neutral and matching conditions, those conditions will be presented here as well.[4]

The hypothesis of this research is that 2-year-olds do not use count/mass syntax to support word learning in either of the two possible ways. That is, count/mass syntax is not used as a means for acquiring Procedures 1 and 2, and count/mass syntax is not used, with Procedures 1 and 2, to constrain the meanings of new words. If this hypothesis is correct, there should be no differences between the three conditions on the object and substance trials.

Method

Subjects

There were 36 2-year-olds, ranging in age from 1;10 to 2;3 (mean age: 2;0). They were evenly divided between three groups: the neutral syntax group, the matching syntax group, and the conflicting syntax group. The first two groups had 12 girls and 12 boys each. The third group had 13 girls and 11 boys. The subjects were tested individually in their homes. The parents of each subject were paid $5.00.

Stimuli

There were four novel object kinds, with two tokens of each. The tokens were made out of different materials. The objects had the following forms: pyramids (wood and Super Sculpey[5]), pancakes (yellow wax and green plastic), kidneys (orange wax and purple plaster), and half eggs (grey styrofoam and red Super Sculpey). There were also eight novel non-solid substances, organized into four pairs: Dippity-do (a setting gel) and lumpy Nivea (a hand cream mixed with gravel); coffee (freeze dried) and orzo (a rice shaped pasta); sawdust and leather (cut into tiny pieces); and Crazy Foam and clay.

Procedure

There were four object trials and four substance trials in each condition that were repeated twice. Before and after testing the experimenter played with the subject. The entire period of involvement

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3. There are no objects in the substance trials, but the subjects could have believed that the new word referred to a certain kind of pile.

4. The neutral and matching conditions are described in more detail in Soja et al., 1990. The data from the 2-year-olds of Experiment 2 of that paper are discussed here.

5. Super Sculpey is a molding compound, similar to clay.

with the subject was tape recorded, but only the productions from the play periods were used in the analyses of linguistic competence. A syntax score was found for each subject that reflected the ability to use determiners and plural endings differentially for the two kinds of nouns.

An object trial in the neutral syntax condition. The child was presented with an object (see Figure 1). The object was given a name. For example, the experimenter said "This is my blicket". The experimenter then continued to talk about the object using "my", "the", and "this" for determiners. She and the subject manipulated the object. The object was placed to the side and two other sets of objects were presented directly in front of the subject. One set contained one object that was the same sort of object as the original but made out of a different material. The other set of objects contained 3 chunks made of the same material as the original object. They were small and in arbitrary shapes. The experimenter said, "Point to the blicket". Both objects of each type were used as the named object across subjects.

A substance trial in the neutral syntax condition. Figure 1 shows a sample substance trial. The child was shown one of the substances, being told, for example, "This is my stad". The experimenter referred to the substance using only "my", "the", and "this" for determiners. For half of the trials, the substance was presented in a single pile; for the other half in multiple small piles. The experimenter and the subject talked about the substance and played with it. In the presentation of test substances the subject was shown 2 substances, the original and the new one, and told "Point to the stad". The original substance was in the alternative configuration, while the new substance was in the configuration used originally with the named substance. Of each pair of substances one member was named and the other was used as the alternative to the original in the test presentation. Each member served in both roles across subjects.

The syntax used in the neutral condition determined that the new word was a noun, but did not indicate whether it was a count noun or a mass noun.

Object and substance trials in the matching syntax condition. The matching syntax condition differed from the neutral syntax condition only in the determiners and quantifiers used when naming the original stimulus. Objects were labelled with count nouns. For example, the experimenter said "This is a blicket". Then in subsequent discussion during the same trial the experimenter said "a blicket" and "another blicket". Substances were labelled with mass nouns. For example, the experimenter said "This is stad", "some stad", and "some more stad". These determiners were chosen because in production they are among the earliest selective determiners used by 2-year-olds (Gordon, 1982). Also, in comprehension, 3-year-olds can determine the subcategorization of a noun based on its previous occurrence with one of these determiners (Gordon, 1985). The test items were prefaced with the neutral "Which is the blicket?"

Object and substance trials in the conflicting syntax condition The only difference between the matching syntax condition and the conflicting syntax condition was in the pairing of syntax and kind of referent. In the conflicting syntax condition mass syntax was used in the object trials and count syntax was used in the substance trials. Again, the test question always used a neutral determiner "Which is the blicket?"

Results

Word Learning Trials

The percent of trials in which each subject chose the test stimulus of the original shape was calculated for both object trials and substance trials. The mean object scores and substance scores for the subjects in each condition were: 93% and 39% in the neutral condition, 86% and 31% in the matching condition, and 77% and 56% in the conflicting condition (see Figure 2).

Figure 2

A three-way ANOVA comparing group (neutral x matching x conflicting) with trial type (object x substance) with sex was conducted. There was a significant main effect of trial type ($F(1,33) = 100.837$, $p < .001$), which demonstrates the main finding that 2-year-olds treat words that refer to objects differently than words that refer to substances. There was also a significant interaction between condition and trial type ($F(2,33) = 6.507$, $p = .004$). A Neuman-Keuls test showed that the interaction was due to the three groups being the same on the object trials but the conflicting group being different than the other two groups on the substance trials. None of the other effects were significant.

Production Data

In order to assess each child's productive command of count/mass syntax, we examined the use of selective count noun frames. Nouns that appeared in neutral syntactic frames (e.g., "the dog", "the mud", "my house", "Sandy's sand") were removed from the analysis. We then calculated for each subject the percentage of count nouns occurring in selective count noun contexts --"a (noun)", "one (noun)", "(noun)-s", "the (noun)-s", "some (noun)-s", and "two (or a higher number) (noun)-s". High scores should indicate good control of count syntax, except

for the fact that some subjects used "a" indiscriminately with count nouns and mass nouns, which yielded a high score that was misleading. To correct for such indiscriminate use, we subtracted from that score the percentage of mass nouns used in selective count noun contexts. The resultant score could be as high as 1, indicating full command of count syntax and differentiation of count and mass nouns, or as low as 0, indicating no productive control of this syntactic distinction. The scores ranged from .05 to .69 (mean .26) and 39% of the subjects scored less than .20. The three groups did not differ (neutral: .25; matching: .34; conflicting: .20; $F(2, 31) = 1.698$, $p > .2$).

We also needed a measure for each subject that reflected the child's differentiation of the object and substance trials. We subtracted the substance score from the object score for each child. Scores ranged from -12 to 100 (mean 43), with high scores reflecting good differentiation of object and substance trials. There was a significant negative correlation between the count/mass score and the object/substance score for the conflicting syntax group ($r = -.62$, $p = .03$). This indicates that the more productive control the subjects showed, the less they differentiated object trials from substance trials. Remember, in the conflicting condition, a small degree of differentiation indicates sensitivity to the syntax. There was no correlation for the other two groups (neutral syntax: .12; matching syntax: .03).

Discussion

Question 1: Do children learn to make the ontological distinction between objects and substances through the count/mass distinction?

The first step in answering this question is to examine the effect of syntax on inferences of word meaning when the syntactic information supported the ontological information. There were no differences between the neutral syntax and matching syntax conditions. These 2-year-olds were not able to use syntax to support Procedures 1 and 2. Furthermore, the children in these conditions showed no correlation between productive control of count/mass syntax and their differentiation of object and substance trials even though many of them had no productive control. This suggests that representation of count/mass syntax plays no role in the development of Procedures 1 and 2. However, it is possible that Procedures 1 and 2 are already so powerful that their effects cannot be strengthened. Although subjects could do better on the substance trials, it may be that Procedure 2 is very strong, but that another factor is inhibiting better responses (see Soja et al., 1990, for a discussion of this possibility). If so, then supportive syntax could not have an effect.

Consequently, the effect of syntax when it conflicts with ontology must be examined. There were no differences between any of the conditions on the object trials. Procedure 1 seems to be impervious to syntactic information. However, there was a difference on the substance trials. The subjects were more likely to select the substance of the

original shape when the new word was a count noun compared to either when it was a mass noun or when its subcategorization was ambiguous. To interpret this result, the individual data of the subjects in the conflicting syntax condition must be considered. The best way to evaluate which subjects were affected by the syntax is to examine the correlation between productive control of count/mass syntax and sensitivity in comprehension to count/mass syntax. The negative correlation between the subjects' production scores and their differentiation of the two kinds of trials indicates that it is just those subjects who produce count/mass syntax that are sensitive to it in comprehension. It also indicates that there are other 2-year-olds who do not represent count/mass syntax in production or comprehension, but who do represent Procedures 1 and 2. In sum, the results of the conflicting condition did unexpectedly differ from the results of the other two conditions on the substance trials. However, that difference was due to the subset of the subjects who already were producing count/mass syntax. Thus, this experiment supports the argument of Soja et al. against Quine's position that children learn the ontological distinction through the syntactic distinction.

Question 2: Are 2-year-olds able to use the subcategorization of a new noun as an indicator of the meaning of that noun?

Some, but not all, 2-year-olds do use syntax to influence their inferences about new words when the referents of the words are non-solid substances. However, they do not use syntax when the words refer to solid objects. That is, when the referent of a new word is a solid object, children use Procedure 1 and, once activated, Procedure 1 is not influenced by syntax at all. This result supports the belief that objects play an extremely important role in children's conceptual and linguistic systems (Spelke, 1985). Future research will investigate the reasons for this difference in the effects of syntax on Procedures 1 and 2.

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Distributional Analyses of Parent-Child Conversational Interaction [1]

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The goal of this paper is to present the results of a distributional analysis of parent-child conversational interaction for three large longitudinal corpora. We will briefly examine the potential role of conversational interaction in language learning and argue that certain sources of conversational input provide children with excellent opportunities to advance their linguistic skills. These input sources will be characterized in terms of a typology of interactions between parents and their children that may be coded and analyzed automatically by using a program called CHIP. Following a description of CHIP, we will present the distributional results and discuss their implications.

1. Interactional Sources for Learning

Children may receive many different forms of facilitative input from their parents. Children receive implicit negative feedback concerning their errors:

(1) *SAR: He no bit ya.
*MOT: No # he won't bite ya.

Or parental expansions may provide children with positive examples of correct usage:

(2) *MOT: What happened to your shirt?
*ADA: Got some choc(olate).
*MOT: You got some chocolate on it # didn't you?

Or they may reveal the membership of various lexical items in certain grammatical categories:

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[1] Portions of this article were taken from a doctoral dissertation submitted to Carnegie Mellon University. I would like to thank my committee members Brian MacWhinney, James McClelland, and Patricia Carpenter for their help. A longer version of this paper is also available. CHIP will soon be contributed to CLAN and distributed by CHILDES. Address for correspondence: Jeffrey L. Sokolov, 306 Larsen Hall, Harvard Graduate School of Education, Cambridge, MA 02138, snowjs@hugse1.bitnet.

(3) *ABE: What you got in your hand?
*FAT: What have I got in my hand?

In Example 3, the parental model reveals to the child that the pairs of *you-I* and *your-my* are grammatically interchangeable. In addition, parental partial repetition of lexical elements from child speech may serve as communicative and cognitive facilitators. Partial repetition may be a communicative facilitator by enhancing topic maintainance and a cognitive facilitator at the same time by reducing memory demands (i.e., lexical access) for the child thereby freeing up more resources for learning.

An interesting comparison would to be examine parental additions to adjacent child speech to determine the rate and pattern of examples provided to the child by the parent and to compare these data with the corresponding values for child deletions of adjacent parental speech. This would provide information about how the amount and pattern of parental input might change as a function of child development. Evidence for this form of contingent input would provide further support for the importance of input in language development. In order to perform this analysis on large corpora of data (over 50,000 utterances), an automatic data coding and analysis program was designed and implemented.

2. The CHIP Framework

CHIP is a computer program for the automatic coding and analysis of parent-child conversational interactions. The program is intended to utilize the data and tools of the Child Language Data Exchange System (CHILDES) as described in MacWhinney (1990; MacWhinney & Snow, 1985). CHIP assumes that data is transcribed according to the CHAT conventions described by MacWhinney (1990). The program was developed to be consistent with the design guidelines (down to the actual code) of the CLAN data analysis programs developed and distributed by CHILDES (MacWhinney, 1990).

CHIP takes as input a computer file containing conversational interaction and adds to it a series of codes describing the similarities and differences between pairs of utterances spoken by different interlocutors. These utterances are called the source and the response utterances. The program is only briefly described in the following sections. For a more detailed and complete description, please consult Sokolov and MacWhinney (in press).

2.1. The CHIP Coding System

The CHIP program looks at pairs of utterances. The first utterance is the "source" utterance and the second utterance is the "response" utterance. CHIP compares the

response utterance to the source utterance and inserts special codes into the child language transcript as a distinct coding tier. In addition, the program tabulates a series of descriptive statistics as it processes a data set (for a description of the summary statistics see Sokolov and MacWhinney, in press).

The following example should provide the reader with a gentle introduction to the coding system. Given the following mother-child interchange:

*CHI:	Truck is red.
*MOT:	The truck is-'nt red.

The CHIP system would produce the following tiers:

*CHI:	Truck is red.
*MOT:	The truck is-'nt red.
%adu:	$EXA:truck-is-red $ADD:the $MADD:-'nt
	$EXPAN $REP = 0.75

The coding tier indicates that the adult response contained an EXAct-match of the continuous string *truck-is-red*, an ADDition of *the*, and a Morphological ADDition of *-'nt*. In addition, since the parent has only added material to the child's utterance, the parental response is also coded as an EXPANsion. Finally, a repetition index is computed for the amount of overlap between the source and response utterances. The repetition index is 0.75 (3 overlapping stems divided by 4 total stems in the largest utterance).

When given a wordlist as input, the program may also code word-class substitutions. For the following example, if the program was given the following list of subject pronouns: *I*, *you*, *we*.

*MOT:	We will be go-ing.
*CHI:	No, you will be go-ing.

The following coding tiers would be produced:

*MOT:	We will be go-ing.
*CHI:	No, you will be go-ing.
%chi:	$EXA:will-be-go $ADD:no $SUB:you $MEXA:-ing
	$REP = 0.80

This coding tier would be described as a continuous EXAct-match of *will-be-go*, an ADDition of *no*, a SUBstitution of *you* for *we*, and finally a Morphological EXAct-match of *-ing*.

2.2. The Automated Coding Process

When CHIP is invoked, it is told by a series of flags who the child and adult participants are and what options to code. CHIP then moves through transcripts of conversational interaction looking for appropriate source-response utterance pairs to code (either child-adult, adult-child, child-child, or adult-adult). When a response utterance is encountered, the program looks backwards (through a window of seven utterances) for the most recent and only the most recent potential source utterance. Only one source utterance is coded for each response utterance. If a source utterance cannot be found within the seven utterance window, the program simply moves forward in the file and starts over. Once a source-response pair has been found, a simple matching procedure is performed. After the matching has been performed, if the amount of overlap is zero or below the minimum specified by the user (the default is zero), then no statistical information is computed and either the code $NO_REP or the code $LO_REP is inserted into the coding tier.

3. A Distributional Analysis of Parent-Child Conversational Interaction

3.1. Method

Three longitudinal corpora from CHILDES (Adam, Sarah, and Kuczaj) were coded and analyzed by the CHIP program. The number and proportion of adult and child operations were tabulated. For the overall analysis, the operations included the addition, deletion, and exact-match of lexical items. For the analysis of word-class differences, the substitution operation was also coded. Parent-child interaction for three different word-classes was examined. The classes included: (1) *modals*; (2) *subject pronouns*; and (3) *nouns*. The list of nouns was generated from the 250 most frequent words in spoken child language as compiled by Hall, Nagy, and Linn (1984). These items were selected to minimize ambiguity. The exact word lists are presented in Appendix A. Non-ambiguous, contracted, forms were also included. For example, the unambiguous form *'ll* was included but not the ambiguous form *'s*. The three corpora of Abe, Adam, and Sarah were divided into six different age sequences: 2;0-2;6, 2;7-3;0, 3;1-3;6, 3;7-4;0, 4;1-4;6, 4;7-5;0. Note that in all tables and figures, each age level will be referenced by the age ending the time period (i.e., 2;0-2;6 will be referred to as 2;6). Both mothers and fathers were included in the analysis but speech from other participants was not coded.

3.2. Amount of Interaction

The goal of this section is to give the reader an idea of the amount of parent-child conversational data that was successfully coded and analyzed by CHIP. Towards this goal, Table 1 lists the absolute number of coded responses for both parent and child for each of the three corpora. The combined total of 151,900 coded interactions is

Table 1: The absolute number of coded responses across age for Abe, Adam, and Sarah.

		2;6	3;0	3;6	4;0	4;6	5;0	Total
Abe	Parent	803	6829	5577	4290	1871	1968	21338
	Child	752	6760	5709	4553	2048	2048	21870
Adam	Parent	2470	4640	5297	4028	2048	1131	19614
	Child	4763	7669	9022	5990	3777	2294	33515
Sarah	Parent	3242	6516	5915	5213	4639	3583	29108
	Child	2721	5719	5213	4351	4966	3485	26455
Total		14751	38133	36733	28425	19349	14509	151900

Table 2: The percentage of overlapping responses across age for Abe, Adam, and Sarah.

		2;6	3;0	3;6	4;0	4;6	5;0
Abe	Parent	0.45	0.40	0.42	0.38	0.37	0.35
	Child	0.41	0.35	0.39	0.36	0.35	0.34
Adam	Parent	0.50	0.48	0.42	0.41	0.37	0.40
	Child	0.28	0.24	0.27	0.29	0.26	0.29
Sarah	Parent	0.26	0.26	0.23	0.24	0.24	0.25
	Child	0.27	0.24	0.16	0.21	0.19	0.19

Table 3: The percentage of repetition within responses across age for Abe, Adam, and Sarah.

		2;6	3;0	3;6	4;0	4;6	5;0
Abe	Parent	0.14	0.11	0.10	0.08	0.08	0.07
	Child	0.15	0.08	0.08	0.08	0.08	0.07
Adam	Parent	0.22	0.22	0.17	0.15	0.12	0.13
	Child	0.10	0.08	0.08	0.08	0.07	0.07
Sarah	Parent	0.12	0.11	0.09	0.09	0.08	0.08
	Child	0.11	0.11	0.06	0.07	0.06	0.05

an extremely large dataset by any measure and could not have been coded manually. In addition, as can be seen in Table 2, a substantial proportion of these responses contain some overlap (at least one word) with their source utterances and are therefore coded for interactional operations. Finally, the percentage of repetition within all responses (including the non-overlapping ones) is listed in Table 3. Interestingly, these general results provide a glimpse of things to come: Both Tables 2 and 3 reveal a developmental trend toward less repetition.

3.3. Patterns of Interaction

In this section, the pattern of interaction for parent and child speakers as a function of child age will be explored. Interactional patterns will be measured by differential usage of the operation types: addition, deletion, and exact-match. The absolute number of words involved in each of the three operation types was transformed into proportions by noting the rate of usage of each operation with respect to the other operations. In other words, if there were thirty additions, fifteen deletions, and five exact-matches for a particular speaker within an age level, the proportional measures for that cell would be 60% additions, 30% deletions, and 10% exact-matches.

Three two-way analyses of variance were performed for the speaker (parent and child) and age (2;0-2;6, 2;7-3;0, 3;1-3;6, 3;7-4;0, 4;1-4;6, and 4;7-5;0) variables. Each analysis was performed with one of the three operation types as the dependent measure. The goal was to determine if there were differences between speakers and whether this difference was a function of the child's age level. Given the young age of the children in the first couple of age groups, we expect to find both speaker and age effects. Parents should produce more additions than children but less deletions. Furthermore, this should change as the child ages by becoming more balanced. With respect to exact-match operations, we would expect only slightly more exact-matches by the parent if only as a strategy to maintain or continue the child's involvement in particular conversations. Finally, as the child's conversational abilities and MLU increase, we might expect to see a slight decrease in the rate of exact-matches due simply to an increase in variety of lexical elements and grammatical devices on the part of the child.

The results for addition operations indicate that these parents and children produce additions at similar rates ($F(1,2) = 1.09, p = 0.4$) that change as the child becomes older ($F(5,10) = 7.55, p < 0.005$) with the rate of parental additions declining and the rate of child additions increasing ($F(5,10) = 33.10, p < 0.001$). The results for deletion operations parallel those for addition. Once again, the overall rate of deletions is similar for these parents and their children ($F(1,2) = 1.2$, $p = 0.4$) and is changing as the child ages ($F(5,10) = 21.97, p < 0.001$); however, in this case, child deletions decrease with age as the parental ones increase ($F(5,10) = 41.10, p < 0.001$). A glimpse at Figure 1 reveals distributional differences

between parent and child speakers for the addition and deletion operations but this difference is diminished as parents and children become more similar to one another at around age 4;0. This is the source of the significant interaction between the speaker and age factors for these two operations. These two results replicate the findings of Snow (1981) who found that early in their development, children predominately delete material from parental speech but as they grow older, they predominately add material. A close examination of Figure 1 reveals that early developmental change is steeper than later change. This indicates a possible non-linear result. The pattern for exact-matches is different. Once again, parents and children produce exact-matches at about the same rate ($F(1,2) = 1.01, p = 0.4$); however, the rate declines with age ($F(5,10) = 34.342, p < 0.001$) at a similar level for both parents and children ($F(5,10) = 0.67, p = 0.66$). This indicates that both parents and children tend to rely less on exact-matches as the age of child increases.

The next question is whether or not the changes in parental values are related in any way to changes in child values. In order to answer this question, three regression analyses were performed for each parent-child dyad: child additions were correlated with parental deletions, child deletions with parental additions, and child exact-matches with parental exact-matches. These three analyses were the only ones performed because we have both theoretical and empirical grounds to predict positive correlations between both parental additions and child deletions and parental deletions and child additions. The theoretical basis is the fine-tuning hypothesis of parental input which would predict both that parents would add about as much as their children delete and the converse. The empirical basis comes from the statistical results discussed in the previous paragraphs. We would also predict similar rates of exact-match operations because the parent and child cannot copy one another until the child is producing the lexical element and then there should be a tendency for both parent and child to do so just as a simple strategy for support of topic maintenance. There is also a methodological consideration in wishing to avoid the possibility of random significant correlations that may occur with large numbers of correlations.

The results for each of the three variable pairings indicated significant positive correlations for each of the three parent-child dyads (see Appendix B). The high positive correlations between child deletions and parental additions suggest that the proportion of child deletions changes at about the same rate as that of parental additions. We can interpret this as indicating that as long as child speech is incomplete, the parent will be augmenting it.

The high positive correlations between child additions and parental deletions suggest the complement of the previous correlations. As the child's MLU and mastery of grammatical devices increases, there will be more additions. Some of these will be relevant to the conversation, some will not. This increase in materials lends itself almost trivially to routine parental deletes. Interestingly, although the

present analysis does not tell us this, a small number of these parental deletions must be responses to overgeneralizations by the child.[2] The third relation, that of child exact-matches and parental exact-matches, is also one with high positive correlations. In this case, both the child and parental production of exact-matches decreases. The decrease in exact-matches can be understood if we assume that conversations become more complex and varied as the child ages. As a consequence of the expansion in the range of lexical devices used, there is less repetition.

In sum, these contingent patterns represent the input children receive over an extremely large range of communicative situations. The patterns should probably not be viewed as evidence of a conscious strategy on the part of the parent. For the most part, they no doubt represent a tendency on the part of the parent to add material not present in the incomplete child repertoire as part of the normal conversational flow. This will be discussed further in the conclusion to this section. With this many source-response pairs, we know that it is possible to further differentiate conversational interaction based on codes that could only be computed manually. Even so, some further distinctions are possible to compute automatically and attempts will be made to do so in the following section.

3.4. Word-Class Differences

We know from the previous section that there is a strong relationship between parental and child interactional variables. In this section, we are interested in determining whether this relationship changes as a function of word-class. We would expect that it would given differences in acquisitional rates and answerhood requirements. To test this hypothesis, CHIP coded and analyzed the three corpora with respect to three different word-classes (*modals*, *subject pronouns*, and *nouns*). The proportional results are graphed in Figures 2-4.

The overwhelming result is that the contingent relationship between parents and their children in conversational interaction is maintained across word-classes. This is especially true for the two closed-class items. For the modals, there is a steep decrease in parental additions and child deletions as the children become older that levels off around 4;0. There is also an steady increase in child additions and parental deletions that levels off around 4;6. In addition, substitutions begin to play a substantial role in conversational interaction around 3;6. This is no doubt due to the heterogenous nature of modals. Since we know from the child language literature (e.g., Brown, 1973) that there is a clear acquisitional pattern in the acquisition of modals, it is not surprising to find developmental differences in

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[2] To perform this analysis, one could execute a keyword search within a chip-coded transcript for parental deletions of particularly interesting items (e.g., auxiliaries) and then code any overgeneralizations that existed by hand.

Figure 1: General CHIP Analysis

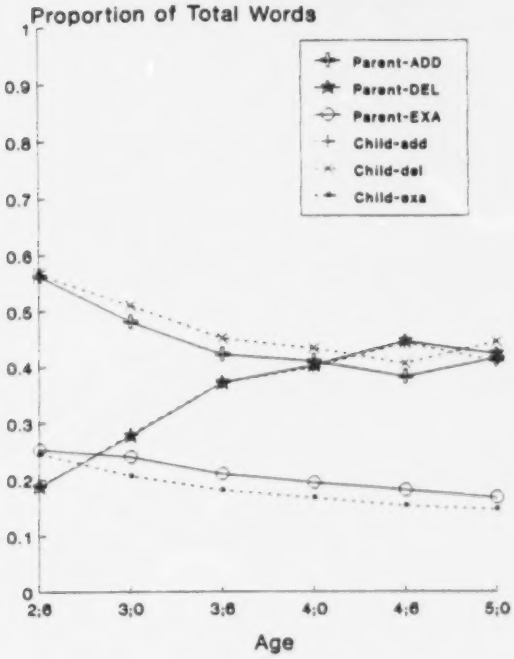


Figure 2: CHIP Analysis of MODALS

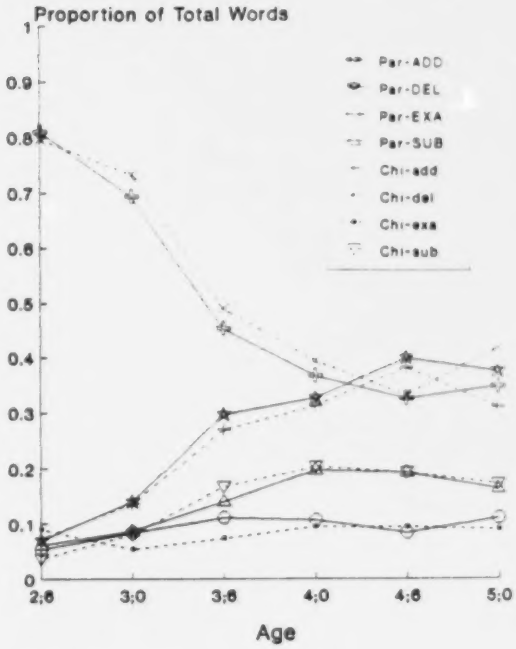


Figure 3: CHIP Analysis of PRONOUNS

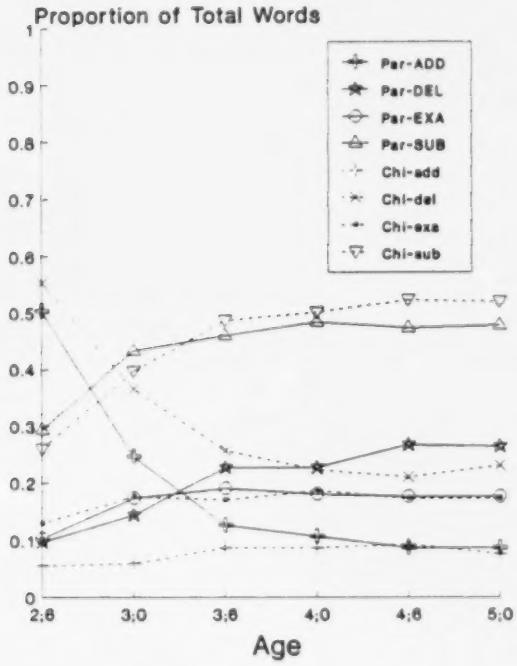
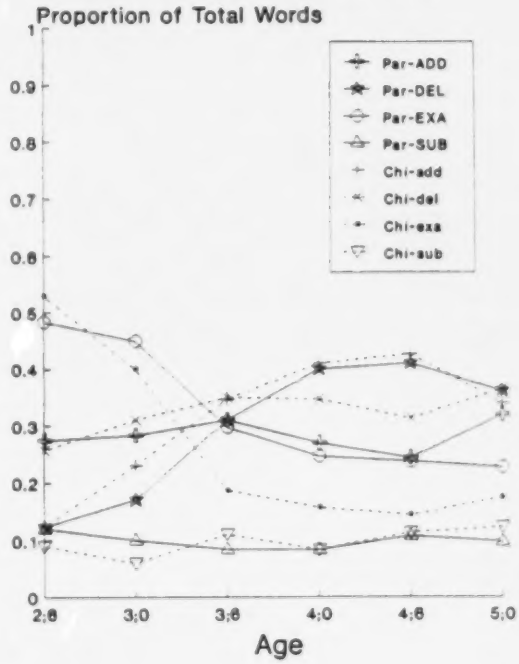


Figure 4: CHIP Analysis of NOUNS



additions and deletions. We can interpret this as indicating that as long as the child is not producing an item, the parent will be providing lots of positive examples of how to use that item in speech. The results for subject pronouns are slightly different: Once the developmental changes for the addition-deletion patterns level off, there is a large increase in substitutions. This is also intuitive since we would expect free substitutions (especially for first and second person pronominals). For the open-class nouns, the patterns exhibit a large proportion of exact-matches early in development that tails off as the children get older.

What exactly is the nature of the differences between word-classes and what could explain these differences? In order to answer this question, it is necessary to discuss the results for groups of word-classes separately. Describing the different interactional patterns for each of the word-classes is largely an expository endeavor; however, explaining the differences requires consideration of several additional issues. For the present discussion, we will briefly explore three classes of concerns: Differing interactional patterns may be due to (1) differing linguistic considerations inherent in each word-class; (2) differing communicative considerations associated with the functional bases of each word-class; and (3) differing rates and patterns of acquisition on the part of the child.

The modals express central notions of tense, aspect, and modality and their position often determines sentential function (i.e., in questions). In addition, children often omit or misuse these items during their acquisition. These general observations are also true, albeit in a different way, of subject pronouns. Pronominal substitution is one of the more central means for expressing person and number in English. Also, substitution is a relatively complex task that children must learn. Since these two closed-class items are central components of English, the parental strategy of adding them to incomplete child utterances is likely to significantly enhance parent-child communication. In contrast, the use of nouns is, by definition, freer than that for the closed-class items and their acquisition also follows a different route. These differences would help to explain the difference in interactional patterns found for the closed-class items as opposed to the open-class one.

Both the results for the full-corpora and word-class analyses indicate highly contingent differences between parent and child speakers as a function of child age and ability. These results are consistent with other recent findings concerning parental input (Hirsh-Pasek et al., 1984; Demetras et al., 1986; Bohannon and Stanowicz, 1988) and continue to suggest that the *no-negative-evidence* claim is, at best, tenuous.

4. Conclusion

The data presented in this article were obtained with the aid of a new research tool: automatic data coding and analysis by computer. Automatic data coding and

analysis programs have many advantages over manual coding. They have the potential to save time and effort *and* to reduce manual coding errors. Importantly, their ease of use greatly facilitates replication. CHIP, an example of such a tool, has provided detailed information concerning the exact nature of parent-child conversational interactions through analyses of over 150,000 utterances. To code and analyze such a large corpus of data would have taken a prohibitive amount of time if performed manually and would have been subject to a large number of coder errors due to the amount of detail involved. In addition, since CHIP not only tabulates quantitative data but also actually inserts codes into the transcripts, it is possible to perform many more analyses on these data. In fact, code insertion provides the best of both worlds allowing the human to direct and focus the computer to search for increasingly detailed patterns.

This section established some basic characteristics of the distributional relationship between parent and child interactional variables. The amount of interaction measured is extremely large and has proven to be extremely reliable. The patterns of interaction reveal close relationships between the parent and child conversational variables that were measured. The most significant result of all is that this relationship remained a strong one across the two closed-class items but not as much for the open-class item. These results indicate that young children hear a very large number of parental responses that include specific lexical additions of closed-class items and that these additions continue to be present in the input until children produce them.

What do these results signify in terms of the fine-tuning hypothesis? Is there evidence that parents purposely fine-tune the level of their speech to their children's developmental status? No, the answer is that these results do not speak to the issue of conscious fine-tuning. The presence of a contingent relationship between parent and child conversational variables should not be taken as an indication that parents are consciously fine-tuning their input. It is much more likely that the patterns represent a general strategy on the part of parents that are communicating with linguistically-immature children to naturally and consistently supply missing elements in contingent speech.

Although the fine-tuning may not be purposeful, it can be argued that the interactional patterns discovered in this section are unique to parent-child interactions. The pattern would obviously not exist for adult-adult speech. The trivial reason for this is that neither adult would be producing telegraphic speech and adult-adult speech is more lexically progressive and less lexically repetitious than parent-child speech. Furthermore even adults speaking to children who are not their own are less likely to provide contingent input (Bohannon & Stanowicz, 1988). This indicates that parent-child conversational interaction has a special quality due to the identity of the participants, and as we have argued with respect to learning, a facilitative one also.

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Appendix A: Word-Lists for the Word-Class Analyses

MODALS: another'll, anybody'll, anyone'll, anything'll, both'll, can, can't, cannot, could, could've, coulda, couldn't, dare, everybody'll, everyone'll, everything'll, he'll, how'll, i'll, it'll, many'll, may, might, mine'll, musn't, must, must've, musta, mustn't, need, nobody'll, none'll, one'll, ought, oughta, shall, she'll, should, shouldda, shouldn't, some'll, somebody'll, someone'll, something'll, that'll, there'll, these'll, they'll, this'll, those'll, we'll, what'll, when'll, where'll, which'll, who'll, whose'll, will, willya, won't, would, woulda, wouldn't, you'll

NOUNS: book, books, boy, boys, butter, car, cars, cat, cats, day, days, den, dens, dinner, dinners, dog, dogs, game, games, girl, girls, home, homes, house, juice, juices, people, piece, pieces, room, rooms, school, schools, shirt, shirts, tape, tapes, thing, things, time, water, way, ways

PRONOUNS: I'd, I'll, I'm, I've, anybody, anybody'd, anyone, anything, couldya, d'you, everybody, everyone, everything, everything's, he, he'd, he'll, he's, I, it, it'd, it'll, it's, naught, no-one, nobody, nobody'd, nobody's, none, nothing, nothing's, one, one's, she, she'd, she'll, she's, somebody, somebody'll, somebody's, someone, someone'll, someone's, something, they, they'd, they'll, they're, they've, we, we'd, we'll, we're, we've, willya, y'all, you, you'd, you'll, you're, you've

Appendix B: Regression Analyses for each Parent-Child Dyad

	Variables	CORR	F(1,4)	Prob (F)
	ChiAdd-ParDel	0.99	496.49	0.000
Abe	ChiDel-ParAdd	0.98	114.51	0.000
	ChiExa-ParExa	0.84	9.69	0.036
	ChiAdd-ParDel	0.99	193.36	0.000
Adam	ChiDel-ParAdd	0.94	32.28	0.005
	ChiExa-ParExa	0.91	18.88	0.012
	ChiAdd-ParDel	0.99	566.24	0.000
Sarah	ChiDel-ParAdd	0.98	115.01	0.000
	ChiExa-ParExa	0.97	63.04	0.001

"WHAT'S MISSING IN DUTCH?"

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0. INTRODUCTION

Theories about child grammar usually try to account for differences between child and adult language. An often noted and presumably universal contrast is that young children produce both sentences with and without lexical subjects even if subjects are obligatory in the adult system. Many different proposals have been offered to explain the phenomenon of missing subjects in child language. Here, I would like to convince you that there is no structural difference between the earliest stages of Dutch child grammar and the adult stage where subjects are concerned.

1. EARLY DUTCH IS NOT A PRODROP SYSTEM

First, I will argue that the missing subjects in finite structures cannot be explained by a theory of prodrop, as proposed by Hyams (1983, 1987a, 1987b, 1989). A prodrop theory would explain null subjects in child language in the same way as null subjects in adult systems like Italian or Spanish: there is a particular parameter setting that allows for null subjects. Without getting into the details of prodrop theories, I will focus on two important implications of positing such a theory for early child language:

(A) missing subjects should occur regardless of the position of the finite verb, as is the case in Italian or Spanish.
(B) we expect a transition away from missing subjects in the acquisition of a non-prodrop language.

These predictions are not borne out for Dutch. I concluded this on the basis of data searches, involving about 3000 utterances from 3 Dutch children between 20 and 25 months old. First, we find missing subjects only in two specific syntactic environments:

(A) when the finite verb is in first position (as is shown under (1)-(2))
(B) in non-finite structures

I will discuss the finite structures first, since prodrop theories specifically deal with these.

(1) Finite structures with verb in first position and missing subject in Dutch child language [1]

a. zakt steeds af (Fedra 23) (<it> keeps sliding down)
(slides-3SG constantly down-PRT)

b. kom zo weer terug (Fedra 23) (<I> will be back in a minute)
(come-1SG shortly again back-PRT)

c. ga kusje geven (Tobias 23) (<I> will go give a kiss)
(go-1SG kiss-DIM give-INF)

(2) Unattested finite structures in Dutch child language: some constituent precedes the fronted finite verb:

a. % steeds zakt af [2] (<it> keeps sliding down)
(constantly slides-3SG down-PRT)

b. % zo kom weer terug (in a minute <I> will be back)

[1] Behind each child's sentence you will find the name of the child who uttered it, plus age in months at the time or recording. The Dutch data from Fedra and Tobias were assembled by Jacqueline Frijn; the data from Chantal by Lisan van Beurden. Laura's data were collected by Jacqueline van Kampen and put into a data system by Jacqueline Frijn (all at University of Utrecht, Netherlands).
[2] The "%" indicates "unattested". Since we are dealing with child language, not intuitions, we cannot make definite claims about "ungrammaticality".

(shortly come-1SG again back-PRT)
c. % kusje ga geven (a kiss I will go give)
(kiss-DIM go-1SG give-INF)

Second, the phenomenon of a missing constituent when the finite verb is in first position is not restricted to child language. Very similar to the data under (1), we find the ones under (3) in adult Dutch. Parallel to the unattested examples under (2), where some constituent precedes the finite verb, you will find the ungrammatical adult examples under (4).

(3) Structures with finite verb in first position and missing subject in Dutch adult language:
a. heb hem deze week al vijf brieven geschreven
(have-1SG him this week already five letters written)
(<I> have written him five letters already this week)
b. geeft haar altijd bloemen op zaterdag
(gives-3SG her always flowers on Saturday)
(I have written him five letters already this week)
(<S/he> always gives her flowers on Saturdays)

(4) Ungrammatical adult Dutch examples: missing subjects when some constituent precedes the fronted finite verb:
a. *deze week heb hem al vijf brieven geschreven
(this week have-1SG him already five letters written)
(This week, <I> have written him five letters already)
b. *haar geeft altijd bloemen op zaterdag
(her gives-3SG always flowers on Saturday)
(To her, <s/he> always gives flowers on Saturdays)

This strongly suggests that very young Dutch children do not have a grammar like Italian or Spanish where missing subjects are concerned. Neither early Dutch nor adult Dutch is a prodrop system. Then how can we explain that we do find null subjects in structures as under (1) and (3)?

2. MISSING CONSTITUENTS IN DUTCH ARE MISSING TOPICS

I will argue that a theory of "topic-drop", as presented by De Haan & Tuijnman (1989) along the lines of Huang (1984) can provide an explanation for the phenomenon of missing subjects in Dutch. For this purpose, it is important to have some understanding of the basic and derived syntactic Dutch structure:
The underlying word order is SOV. In main clauses, where no complementizer fills the COMP-node, the finite verb has to move to COMP. To derive declarative word order, some constituent has to be topicalized to a position immediately preceding COMP, thus creating the well-known V2 effect. The relevant structures are shown in (5)-(6).

(5) Underlying structure in Dutch (embedded finite)
zij zei $[_{CP}$ $[_{C}$ dat$][_{VP}$ Lisan $_{S}$ me $_{IO}$ dit $_{O}$ $[_{V}$ heeft gestuurd$]]]$
(she said that Lisan me this has-3SG sent-PSTPRT)
(she said that Lisan has sent me this)

(6) a. Subject topicalization:
$[_{topic}$ Lisan$_{i}]$ $[_{CP}$ $[_{C}$ heeft$_{k}$ $[_{VP}$ $[_{i}]$ me dit $[_{V}$ $_{k}$ gestuurd$]]$
(Lisan has-3SG me this sent-PSTPRT)
(Lisan has sent me this)
b. Object topicalization:
$[_{topic}$ dit$_{i}]$ $[_{CP}$ $[_{C}$ heeft$_{k}$ $[_{VP}$ Lisan me $[_{i}]$ $[_{V}$ $_{k}$ gestuurd$]]$
(this has-3SG Lisan me sent-PST-PRT)
(this Lisan has sent me)

Now in certain languages, an empty topic can identify an empty element in the clause on the basis of contextual information (Huang 1984). Thus, in (7) the topicalized subject Lisan has been dropped, and in (8) the object dit (this). For these examples, I have included possible discourse contexts to enhance clarity, and consequently the chance of convincing you.

(7) Topic drop - topic=subject:
discourse: Wat deed Lisan? (What did Lisan do?)
heeft me dit gestuurd
(has-3SG me this sent-PSTPRT) (<Lisan> has sent me this)

(8) Topic drop - topic=object:
discourse: Waar heb je dit vandaan? (Where did you get this?)
heeft Lisan me gestuurd
(has-3SG me Lisan sent-PSTPRT) (<this> Lisan has sent me)

Topic-drop explains why we only find finite sentences with missing subjects when the verb is in first position. The derivation of Dutch declarative main clause word order creates an excellent environment for topic drop: in declarative main clauses there always is a topicalized constituent. What is missing in Dutch is not directly an object or a subject, but a topic, both in child and adult language.

3. WHY LEXICAL SUBJECTS ARE OBLIGATORY

If the Dutch child system is like the adult's, this implies that somehow lexical subjects are required even for the youngest Dutch child. Many interesting proposals have been made that link missing subjects to the lack of inflection in early child language (a.o. Clahsen (1987), Lebeaux (1987), and Jaeggli & Hyams (ms-19xx)). Unfortunately, I will not be able to discuss these within the boundaries of this paper. What is important here is that the Dutch developmental facts seem to contradict the hypothesis that the youngest Dutch children do not have any sense of verbal inflection or subject-verb agreement at all.

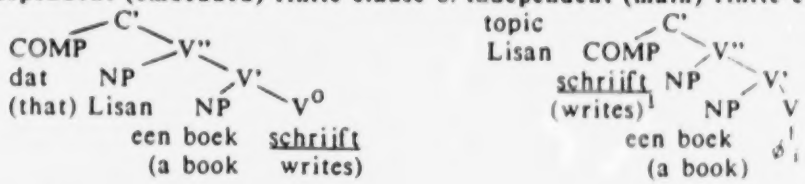
Subject-verb agreement in Dutch child language
First of all, the data show a distinctive distribution between the finite forms of a verb and infinitive ones. The first occur only at the left periphery (first or second position), the latter only at the right periphery (De Haan 1986). If the child had no way of distinguishing between different verbal forms, we would not expect this. Examples are given under (9) and (10).

(9) finite examples: finite verb at left periphery
a. ik ga ook douchen (Laura 23) (I will also take a shower)
(I go-1SG also shower-INF)
b. moet Kees taartjes bakken (Tobias 20)
(must Kees pastries-DIM bake-INF) (Kees has to bake pastries)
c. zakt steeds af (Fedra 24) (<it> keeps sliding down)
(slides-3SG constantly down-PRT)

(10) infinitive examples: finite verb at right periphery
a. limonade drinken (Tobias 20)
(lemonade drink-INF)
b. vogeltje taartje bakken (Tobias 20)
(bird-DIM pastry-DIM bake-INF)
c. Kees huilen (Tobias 20)
(Kees cry-INF)

We can explain this exclusive distribution most naturally if the leftmost verbal position is COMP from the earliest stages on, just like in adult language. During the first developmental stages, the child does not have embedded clauses yet. The COMP-node is strictly finite and strictly verbal at first. I follow Weerman and assert that the COMP has to be lexical in Dutch to assign a modal role and finiteness features to the VP. The modal role involves the speaker's attitude toward the truth value of the proposition that is expressed. The lexicalization of COMP can be effected by either a finite complementizer or a finite verb. But in early child language, the only way a sentence can be finite is when the verb occurs under COMP. When the child acquires embedded clauses, COMP can also be lexicalized by a finite complementizer, and the finite verb can then appear in base position at the right periphery. COMP has to be lexicalized to assign finiteness features to the VP, so that the finite verb can appear under V^0. The I-affix is the morphological reflex of these finiteness features. The structures under (11) exemplify this.

(11) a. **dependent (embedded) finite clause** b. **independent (main) finite clause**



Compare to:
c. *Lisan een boek schrijft (*empty finite COMP)
(Lisan a book writes-3SG)
d. *dat schrijft Lisan een boek (*complementizer + V in COMP)

Second, if you compare the adult's paradigm (12) with the examples under (13), you can conclude that all the inflectional affixes that occur in the adult system are already available at a very young age.

(12) ADULT PARADIGM

FINITE (pres.tense) INFINITIVE +(e)n

SG	PL
1. -	+(e)n
2. - or +t	+(e)n
3. +t	+(e)n

STEM: -

(13) EXAMPLES FROM CHILDREN (20 - 24 months old)

FINITE VERBS (LEFT PERIPHERY):

without affixation	**with affix**
(-)	(+t)
ga, doe, hoef, pak, denk	gaat, doet, valt, blijft
(go, do, want, take, think)	(goes, does, falls, stays)
sta, voel, kom, hoor	ligt, komt, slaapt
(stand, feel, come, hear)	(lies, comes, sleeps)
	(+(e)n)
	moeten, zitten, gaan, doen
	sit, go, do)

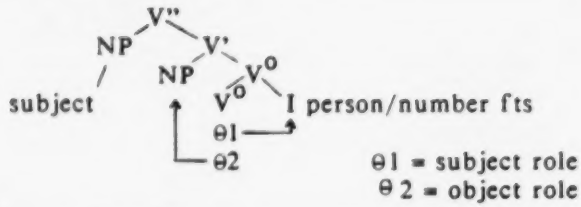
INFINITE VERBS (RIGHT PERIPHERY)
(+en)
slapen, drinken, maken, pakken
(sleep, drink, make, take)
huilen, wassen, kopen, spelen
(cry, wash, buy, play)

Third, young Dutch children make astonishingly few mistakes in matching a particular verb form with a specific subject, i.e. in having subject-verb agreement. Out of 388 finite utterances with subjects that I checked, I found only 2 forms that were clearly deviating from the paradigm, i.e., the child made a "wrong" combination of a subject with a particular verb form. Therefore, theories that crucially depend on the assumption that child language differs from adult language in that children do not have inflection yet, cannot directly account for the Dutch data. Fortunately, Dutch does not seem to be the only deviant language where the early verbal system is concerned. Recent work on German and French language development provides additional evidence (Hulk (1987), Weissenborn (1988, forthcoming), Verrips & Weissenborn (forthcoming)). There, it is also concluded that children distinguish between finite and non-finite verb forms, and seem to have a sense of subject-verb agreement at a remarkably young age. This does not have to imply that the young child must already have a productive agreement paradigm. It may be that it acquires verbal morphology by building up a word-specific paradigm first, as De Haan (1986) claimed, following Pinker (1984). Every verb form could first be learned with an inherent agreement connotation, before the child realizes that the affix bears this information rather than the entire verb form.

Subjects as specifiers

I will proceed to propose an explanation for the subject requirement, based on subject-verb agreement. On the basis of Weerman (1989), I argue that a subject has to be lexically present to specify the person-number reference that every finite verb has, from the earliest stages on. The V-projection bears the subject -role, which is identified via its inflection, i.e. in finite clauses via the the person and number features. According to Weerman, the I does not have its own projection. I exists as an affix on the head V^o, and is the morphological reflex of information contained in COMP. The only verbal positions in a structure are the V- and COMP-position. The VP-structure and the θ-assignment are exemplified in (14):

(14)



The subject θ-role does not get assigned to a particular syntactic position as is usually assumed, but is assigned only morphologically, to the I-affix. If the morphological features that identify the subject θ-role are somehow "strong" enough, subjects are not obligatory. The person-number reference is then solely determined by inflectional morphology. In languages like Dutch, where the subject reference cannot be determined unambiguously by the person-number features, a subject is required to specify these features. This is defined in Weerman's parameter:

(15) **person-number specification parameter**:
the person-number features have to be
- obligatorily specified
- optionally specified Weerman (1989)

4. INDEPENDENT NON-FINITE STRUCTURES

From this perspective, it is predicted that subjects are not obligatory when there are no person-number features. This is the case with non-finite structures. This involves both projections of infinitive verbs and projections without verbs, the only other syntactic environment where subjects are optional in Dutch. Again, there is no difference between child and adult language here. In (16) and (17) examples are given with and without subjects. The subject constituents are underlined.

(16) Children's independent non-finite structures
a. blaadjes tekenen (Fedra 23)
(leafs-DIM draw-INF)
b. mamma ook een happie eten (Laura 24)
(mommy also a bite-DIM eat-INF)

(17) Adult's independent non-finite structures
a. (Jij) naar Californie fietsen? (Nooit!)
(You to California bike-INF? Never!)
b. (Lisan) taarten bakken? (Laat me niet lachen!)
((Lisan) pastries bake-INF? Don't make me laugh!)

Independent non-finite structures are a typical but insufficiently explained type of structure in Dutch. It is not true that an "infinitive stage" precedes the use of finite structure, even if non-finite structures represent the majority of utterances at first. Finite structures as under (9) occur at all the same stages as the non-finite ones as under (16). And again, independent non-finite structures exist in the adult language as well.

SUBJECT-PREDICATE RELATIONS
The underlined constituents in (16)-(17) bear a subject relation to the infinitive verb, but cannot be subjects by virtue of subject-verb agreement. The infinitive affix -(ę)n is not specified for person-number features. Under (18) I list the properties of independent non-finite structures, which are illustrated by the examples under (19) and (20), in addition to the ones under (16) and (17).

(18) Independent non-finite structures
a. no person-number features => no subjects required
b. free combination of any two XP's:
=> neither XP is obligatory
=> topic and comment can each be any type of constituent, not just NP and VP (all examples under (19)-(20))
=> subject-predicate relations can exist between two constituents that are not NP and VP (eg. 19b, 20c).
=> other than subject-predicate relations between topic and comment exist (eg. 19a, 20a,b)

(19) Child Dutch
a. [zo][beter]? (Chantal 24) ADVP AP
(this way better?)
b. [ikke][op je nek] (Laura 24) NP PP
(I on your neck) (subj-pred)
c. [Joris][blote voeten] (Willemse 1987) NP-NP
(Joris bare feet)

(20) Adult Dutch
a. [op de fiets][naar Californi]? Nee toch! AP PP
(on the bike to California? Surely not)
b. [morgen][met vakantie]? Toe maar! ADVP PP
(Tomorrow on vacation? Wow!)
c. [Eric Flaim][wereldkampioen]? Nooit meer. NP NP
(Eric Flaim world champion? Never again) (subj-pred)

Since these structures all lack person-number features, it is predicted that subjects are not obligatory. I propose that the constructions under (16)-(17) and (19)-(20) are instances of "topic-comment structure", i.e. a free combination of any two constituents. Neither topic nor comment is ever obligatory. The relation between topic and comment is established through coindexation. Thus, if the comment happens to be a VP, it will carry the subject role. Coindexation with a topic can then result in a subject-predicate relation.

Illocutionary roles
If the child has basically the same grammatical structure as the adult, how can it be that we get the impression that child language is so different from adult language? I will show that there is a subtle non-structural difference between the adult's and the child's topic-comment structures. For adults, most topic-comment structures are impossible with a declarative illocutionary force. Thus, the examples under (18) would be impossible as declaratives in adult Dutch. We can explain this when we take a closer look at the different functioning of COMP in adult language as opposed to child language. According to Weerman, the illocutionary role is derived from the particular modal role, that is assigned by finite COMP. The illocutionary reference is independent when COMP is filled by V, but dependent when filled by a complementizer. So, to get a declarative reading, a finite verb has to be in COMP, and some constituent is topicalized. For adults, a non-finite clause would normally be embedded. An embedded non-finite clause has a [-finite] COMP, that does not get lexicalized. It depends on the matrix clause for mood, tense and subject reference. The independent non-finite structures typically do not have a COMP node. So, if COMP plays a central role in deriving modality in the adult system, and the illocutionary force follows from this, it is predicted that the topic-comment constructions normally do not occur with a non-declarative reading.

At the stage where topic-comment structures occur as declaratives, the child does not have embedded structure yet. COMP only exists as a site for finite verbs. There are

no empty, [-finite] COMPs for the child. At the same time, the child is capable of generating different utterances with different illocutionary forces, such as orders, questions, desires, just like adults, through word order and intonation. So, apparently, the derivation of the illocutionary force is not crucially centered around COMP yet. COMP does not have the full range of abstract functions, but exists solely as a finite verb node. Consequently, the child is not restricted to only finite clauses for declarative sentences.

5. A SUBTLE TRANSITION

We have seen that there is a subtle difference in possible illocutionary forces in children's topic-comment structures, compared to the adult ones. Also, Clahsen (1987) has shown for German that there is a decrease in the percentage of utterances without subjects when the children acquire the morphological means of productive verbal inflection. As I pointed out, the systematic difference is not syntactic in nature, but involves the illocutionary force, which is centered around the functions of COMP. I will show you how the change in illocutionary force is one of many changes centered around the functions of COMP. In (21) I state the related phenomena, comparable to Clahsen's developmental stages for German [3].

(21) Predicted related acquisitional evidence
A. embedded clauses: COMP not only as finite verb anymore
V-position not only infinitive anymore
B. productive agreement paradigms (affixation)
C. decrease/loss of declarative topic-comment structures
D. rise of structures with finite verbs
E. decrease in overall percentage of missing subjects

First, once subordination and thus the complementizer system have been acquired, the full range of abstract functions of COMP must be available to the child. The acquisition of embedded clauses occurs somewhere around the 40th month, according to Clahsen's stages. At about the same time, there is a rise in structures with fronted verbs.

Under my proposal, the coinciding of the phenomena under (21) is not a coincidence. (A) When COMP is filled by a finite complementizer, it can assign finiteness and a modal role to the VP. A finite verb can then occur under the right peripheral V-position as well as under COMP. (B) The inflectional affix on the finite verb is the morphological reflex of the finiteness features assigned by COMP. Consequently, the child should realize that the finite verb is morphologically complex. Indeed, Clahsen also claims that at this stage, the agreement paradigm is acquired, i.e. the child productively uses present and past tense affixation. (C) At this point, we expect a decrease in topic-comment structures as declaratives. A non-finite construction has an empty [-finite] COMP as in adult language, and is thus expected to be dependent, so that mood, tense and person-number features can be specified by the matrix COMP and verb. (D) Under the assumption that the child will not diminish the number of declaratives in its speech, it is predicted that we will find relatively more finite sentences from then on. The only verb-final sentences we will find after the acquisition of subordination will then be either embedded or non-declarative. (E) A decrease in the overall percentage of missing subjects is predicted by my theory in two ways: first, the independent non-finite structures account for a large percentage of subjectless sentences as long as they are used as regular declaratives. But when subordination is acquired, these structures largely disappear as declaratives. Embedded non-finite clauses typically do not have subjects, as (22) indicates:

(22) a. *hij belooft [hij mij te schrijven]
(he promises he me $_{IO}$ to write-INF)

[3] The predictions that follow from my theory and are asserted by the findings of Clahsen for the older children have to be checked for Dutch, of course. Unfortunately, at this point, I do not have access to Dutch data of children over 26 months.

b. hij belooft [mij te schrijven]
(he promises me $_{IO}$ to write-INF)

Consequently, embedded non-finite structures would never be counted as having a "missing subject" and the percentage of utterances with missing subjects would surely drop. Second, we have seen that sentences with the finite verb in COMP allow for missing subjects through topic-drop in both child and adult Dutch. It is very probable that this is true for German too, since German is an SOV-V2 language like Dutch. Missing subjects never occur in other environments than this. That means, when embedded clauses are acquired the child gains a structure that never allows for missing subjects. Again, it is clear how the percentage of utterances with subjects may rise because of this.

6. CONCLUSION

I have argued that Dutch child language provides strong evidence against an initial prodrop parameter setting. In both child and adult Dutch, subjects are necessary elements in finite clauses, to specify the person-number reference. Only through topic-drop are topicalized subjects allowed to be missing. In non-finite structure there is no syntactic requirement for subjects, since there is no person-number reference. The Dutch child seems to have some knowledge of inflection, and a sense of subject verb-agreement at a remarkably young age. Similar conclusions have been drawn for early French and German. In view of this cross-linguistic evidence, proposals to explain missing subjects in English through a lack of inflection deserve serious reconsideration.

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Do Young Children Linguistically Encode the Notion of Agent?

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The claim that children's early word combinations are best described in terms of semantic categories such as agent rather than abstract categories such as subject is largely undisputed. This claim rests on the assumption that two-year-olds have a notion of agency which is used as a springboard or bootstrap for getting into more formal categories. If it turns out that children only have a partial notion of agency, then just about every semantic theory that uses agency as a wedge into grammar will need some realignment. In this article I will examine what is known about the development of children's conceptions of agency in the first years of life. I then will reexamine the literature concerning children's early word combinations and will question whether there is evidence to support the claim that young children encode agent-action relations. The implications of this reanalysis for theories of language acquisition will then be reviewed. Finally I will conclude with some comments concerning directions for future research.

1.0 The Development of Agency and Intentionality

An examination of how the notion of agency is used in linguistic theorizing and developmental psychology points to some crucial differences. Recent discussions in the linguistic literature have emphasized the extent to which the notion of agentivity is based upon a semantic prototype involving a number of factors including issues of animacy, volition, and control (see DeLancey, 1987; Lakoff, 1977). In contrast, developmental psychologists have drawn a distinction between the development of a concept of agency and intentionality. Agency is related to the understanding that animate beings move and behave in a causally independent manner, while intentionality is taken to be a developmentally more advanced notion which includes a consideration of the internal states that guide behavior (Poulin-DuBois & Shultz, 1988). These definitional differences are important to keep in mind when drawing conclusions about the developing child. In this article since our primary interest is with the developing language system, we will draw upon the definition of agency as defined in the linguistic literature. We will examine the developmental literature with the question of whether children by the early phases of language development show evidence of having a notion that animate beings (and in particular, humans) act responsibly and with intention to bring about change.

The claim that young children have a concept of agency draws upon studies of children's language and symbolic play. By the end of the second year children have been noted to talk about others as "doers" of action. Around this time children also begin to use replica objects as actors in their play (Corrigan, 1982; Wolf, 1982). Have children shown any evidence of a growing sense of agency before such symbolic developments take place? A variety of studies indicate that before the onset of language development children begin to recognize the distinction between animate and inanimate objects to the extent that they show an awareness that only animate objects can act on their own (Golinkoff, Harding, Carlson, & Sexton, 1984; Poulin-Dubois & Shultz, 1988; Sexton, 1983). At best, these studies show some budding awareness on the part of the child of the concept of animate mover.

Other research has examined the development of an understanding of intentionality in the young child. It has been fairly widely accepted that the development of an understanding of others' intentions is revealed in the emergence of intentional communication for instrumental purposes during the last part of the first year of life (Bates, Camaioni, & Volterra, 1975, among others). While such communicative overtures are revealing of the child's awareness that others can be used instrumentally, these studies as such do not indicate that infants understand the role of mental states in guiding and controlling action. In fact very little attention has been given to children's developing understanding of other people's plans (Pea, 1982).

Taken together the general conclusion that can be drawn from the developmental psychological literature is that by the onset of children's first word combinations, and even well into the third year of life, children are continuing to grow in their understanding of aspects of the notions of animacy, intentionality, and control. Evidence indicates that the concept of agentivity develops only gradually with distinctions made between an understanding of Self and Other as agent over the first years of life.

2.0 The Notion of Agency in Studies of Child Language

An examination of numerous studies of children's first word combinations in terms of semantic categories such as agent, experiencer, patient, etc. suggests that children, from their earliest word combinations, use the notion agent (Bowerman, 1973; Brown, 1973; among others). These studies, though, seem to work with a definition of agent similar to that used by developmental psychologists (i.e. animate mover) rather than one found in recent linguistic discussions (i.e. intentional, controlling actor). Thus while such research might be taken to suggest that

agency plays a central role in children's early word combinations, I will show that other studies leave reason to believe that children may work with more refined categories. The claim put forth here is similar to that suggested by Braine (1976) with regard to limited scope formula, though as we shall see, the nature of the categories suggested and the method for arriving at these categories differ from Braine's proposal.

The claim I wish to support is that agentivity plays a major organizing role in grammatical development, though children's notions of agentivity may first be limited to the Self. Slobin (1985) suggests that children acquiring distinct inflectional languages reserve the use of particular grammatical forms to mark the notion of an agent acting willfully and with purpose to bring about a change of state in an object. In an attempt to assess whether English-speaking children also give special grammatical treatment to a cluster of features relating to agentivity and control I examined the spontaneous productions of six American children acquiring English. Based on careful distributional analyses of who the children referred to and what forms they used I came to the conclusion that half of the children, the three least linguistically sophisticated children, primarily referred to Self as main participant in their multi-word utterances. The three more advanced children referred to Others as well. To briefly summarize the central claim of this research, I have suggested that at a time before the children regularly referred to Others, they reserved the use of a variety of first person pronominal forms to talk about Self as prototypical agent and various deviations (see Budwig, 1986, 1989).

The findings of this research, in contrast to previous claims about the notion of agency in early child language, suggest that English-speaking children give special linguistic treatment to a sub-category of agency, namely, Self as agent. The idea that children may draw a distinction between talk about Self's involvement in actions and Other's involvement in actions is not new. Huttenlocher, Smiley, and Charney (1983) have provided naturalistic and experimental evidence that suggests that children's early verb usage first encodes the children's own involvement in actions and only subsequently encodes the involvement of others. This finding also fits well with the developmental literature reviewed above that suggests that children only gradually construct the notion of agent over the course of the first three years of life.

The question remains, though, what is the developmental path with regard to the linguistic marking of Others as agents? Wertz (in progress) is presently examining form-function relationships in children's early talk about others (MLU range: 1.53-3.32).

Though the analyses have not been completed, it appears as though there is no evidence that the children give special linguistic treatment to Others as agents acting with volition to bring about a change of state. When the children talk about others in relation to carrying out particular action sequences, often it is the child who is the seat of control or volition for the action. That is, the child uses the adult instrumentally to achieve personal goals. In addition, the children refer to salient actions undertaken by others in the immediate past or that the others are currently engaged in, though there is no commitment to intention or control.

There has been much agreement that in their first word combinations children talk about agent-action relations. Our review suggests that if we are to except this claim we will need to specify that by agent we mean something like "animate mover". Relying on this general definition of agency glosses over another very important finding. If we restrict our use of agency to a prototype involving a cluster of features including animacy, volition, and control, and use the broader term "actor" to mean something like animate mover, then the following pattern emerges. In the earliest phases of language acquisition children acquiring English reserve the use of special grammatical forms to mark the category of Self as agent and various related distinctions. Simultaneously, or soon thereafter, the children begin talking about Others as actors. Whether this pattern can be extended to children acquiring other languages is an important area for crosslinguistic research.

3.0 Implications for Theories of Language Acquisition

What are the implications of our previous discussion for current theorizing in the area of language acquisition? One might want to suggest that we simply have been talking about "definitional" issues, and that whether children early on work with a notion of agency (where agency implies a consideration of the related notions of animacy, volition, and control) or what has been referred to as the more general category of actor (Braine, 1976; Van Valin, this volume), will have little impact on current theorizing. I would like to turn to consider how assumptions about agency might impact on two acquisition theories, namely, Gropen's review of Pinker's Semantic Bootstrapping Hypothesis and Van Valin's discussion of Role and Reference Grammar.

In his revised Semantic Bootstrapping Hypothesis, Pinker (1989) has added a separate conceptual structure which in turn requires the addition of two assumptions. The revised model rests on the assumption that children construe the world in a way quite similar to the adults speaking to them (see Pinker, 1989, p.

362). A second assumption is that parents use only semantic representations that correspond to the child's conceptual encodings of the world. From these assumptions, Pinker claims that the child makes use of linking rules to get at the syntactic representations of the language being acquired. While Pinker's new model clearly resolves some problems inherent in his previous two box version, the evidence reviewed above concerning children's early conceptualizations and linguistic marking of agency propose certain problems for the revised version. First, evidence suggests that with regard to the semantic notion of agency there is reason to believe that two year old children and adults do not encode the world in the same way. Second, children do receive linguistic input that does not seem to correspond to the child's conceptual encoding of the situation. Note that the problems I have been raising are not with the suggestion that children exploit syntactic-semantic correspondences, nor with the notion of linking. The problem lies with two of the assumptions that pave the way for the child to semantic representations and semantic bootstrapping.

Van Valin's proposal, which draws upon the distinction between actor and agent fits very well with the developmental evidence reviewed above. What it suggests is the need to consider whether the semantic categories of agent and actor are not best viewed in terms of a hierarchical structure, with the category of actor being a higher level category than agent. The empirical data reviewed above suggest the need for future work to look more closely at the notion of person. It seems plausible that children may work at different levels of semantic structure, first reserving the notion of agent for Self, while the macrorole of Actor may function for Other. It would be intriguing to examine further the developmental path concerning the interplay between these two levels.

4.0 Future directions

With the space that remains, I would like to turn to a brief consideration of three issues that need to be addressed in future considerations of the role of agency in early child language.

<u>The role of speaker perspective</u>: Thus far our discussion of agency has focused on notions of animacy, causal instigator, and the like as if the link between conceiving of events and talking about them in discourse comes about in some pre-fabricated way. One of the tasks for speakers is to decide whether particular instances should be treated like agents or not. First of all, adults of a given language might view a situation as agentive, when children of a particular age might not. In addition, one and the same event can be viewed from multiple perspectives and

either adults or children may or may not opt to linguistically focus on the agent's involvement in a given discourse context. In recent work examining children's passive constructions in both naturalistic and experimental settings, I have found that children employ the passive in utterances they wish to mark as deviating from prototypical agency (Budwig, 1990). Clark and Carpenter (1989) have also argued that in particular contexts children encode agents as sources. Slobin (to appear) in a crosslinguistic study has shown that pre-school age children (the youngest age group represented in the study) already made use of the devices for de-emphasizing agency that are provided by a given language in their narrative discourse. The linguistic encoding of agency is not an automatic encoding of some objective viewing of the world. Speakers adopt particular perspectives on events, and one and the same event can be presented from a variety of vantage points. Decisions as to what is treated as an agent will necessarily need to consider both pragmatic and discourse factors.

Socio-cultural factors influencing our views of agency: A second issue that needs further consideration concerns the extent to which our particular socio-cultural views of agency affect the kinds of conclusions we draw regarding children's early notions of agency. Thus far our consideration of agency has separated out the agent from a broader social order. Taylor (1985, 1989) has argued that this sort of theoretical and methodological stance, which views the central unit of analysis as the individual agent acting on its own as grounded in a framework of individualism, has left its mark on almost all of Western social science. Individuals do not act in a socio-cultural vacuum and what counts as an instance of agency in one culture may not in another. Individuals rarely act independently of others. In the future we will need to worry more about the interaction between socio-cultural ways of viewing agency and how such views influence children's talk about agency. Notions such as social responsibility need to be integrated into the agency prototype (Ochs, p.c.). We have only begun to deal with the simplest aspects of the agency prototype and have not begun to worry about how children linguistically encode more complex, culturally specific ways of viewing actors in events. As a first step in this direction we are examining the specific input children receive about agency and how such input might affect the development of grammatical categories and relations (see Budwig & Wiley, 1990).

A methodology for assessing children's early notions of agency: One of the central claims of this article has been that there is little in the way of convincing evidence that children acquiring English linguistically encode a general notion of agency in their early talk. Some of the data I have reviewed suggest that an

understanding of children's linguistic encodings of agency will necessarily depend on a simultaneous analysis of the notion of person and voice. In future developmental work we will need to pay closer attention to the relation between language forms and the linguistic expression of agency. An excellent starting point would be an examination of the forms used by a given language to talk about agency, as well as a consideration of what aspects of agency receive linguistic treatment by speakers. Crosslinguistic research may reveal that the range of forms available in a given language may influence the semantic categories children construct. We must also simultaneously examine what children opt to encode and the various distinctions they take as relevant at different developmental phases. The methodology proposed here has been employed in recent years by a variety of researchers examining different components of grammatical development from a functional perspective (see Bamberg, 1987; Bamberg, Budwig, and Kaplan, in press; Budwig, 1989; Ervin-Tripp, 1989; Gee & Savasir, 1985; Slobin, 1988; among others).

About fifteen years ago Braine (1976) cautioned us that children's semantic categories may differ radically from those of adult speakers. At that time though a research methodology was not widely used that would allow researchers to draw conclusions about the nature of children's semantic categories. Only after a careful analysis of how children linguistically encode the notion of agency in a variety of languages - that is, what forms they use and in what contexts - can we really begin to assess whether the theoretical approaches currently postulated regarding the role of agency in early child language will need revisions due to assumptions that may not be accurate.

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Cross-linguistic Evidence for the Structure of the Agent Prototype

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Much work on the study of case roles in general, and of agentivity in particular, has suffered from an inflexibly deductive approach. There is a tendency to approach any problem related to agentivity or its syntactic reflexes with a preassumed semantic model, involving, in particular, volition (however defined) and humanness or animacy as criterial features of agentivity. Morphosyntactic facts which appear to be inconsistent with this model regularly emerge, no matter what language is being investigated.

The correct line of investigation requires an inductive approach to determining the semantics of agentivity. While an a priori notion of what it is to "be an Agent" may be appropriate for philosophical investigations, we as linguists must be concerned with those semantic categories which are reflected in the morphosyntax of language, or of some particular set of languages, and any attempt to construct a model of this category must involve induction from linguistic facts. In this paper I will briefly review some cross-linguistic evidence concerning the place, in a model of agentivity, of volition, animacy, and person.

Let me begin by stating several assumptions which underlie the argument presented here. First, case roles are semantic, i.e. they have semantic content. An understanding of the role of agentivity in syntax must be based on an understanding of the cognitive structure which is indexed by agentive morphosyntax. Like other semantic categories, agentivity behaves, in terms of its linguistic expression, like a prototype category, that is, there is evidence for degrees of agentivity.

The semantic content of the Agent category is intensional. Agentivity is not an objective phenomenon of the real world; it is a relation which can be predicated of particular participants in particular reports of particular events. An argument "is" an Agent only in a particular clause; it makes no sense to say, without reference to a particular clause, that some entity in some event objectively "is" or "is not" an Agent.

The only relevant evidence for the semantics of case roles is linguistic evidence. That is, we identify agentivity by its morphosyntactic stigmata, not by a priori notions of what "real" Agents act like in the real world. So, for example, if we postulate that a NP in the *by*-phrase of an English passive is Agent, then *the wind* in *A lot of trees were blown down by the wind* is an Agent, and there's no sense getting into a lot of arguments about why it isn't a "real" Agent--in that clause it is a real Agent. (Note the lack of a corresponding ??*The door was opened by the key*.)

The claim that the Agent category behaves as though it had a prototype structure implies that one should be able to find linguistic

evidence for both more and less restrictive definitions. I will present data which support a less restrictive notion of agency than is often assumed, one in which neither animacy nor volition (however defined) is an essential part of the definition. I will then present some evidence suggesting a much more restrictive notion of agentivity than is normally accepted, in which the prototypical Agent is not only human and acting volitionally, but is first person as well. It is perhaps not needless to say that I present these two views of the nature of agentivity as complementary rather than mutually contradictory.

Animacy and volition

In several papers (DeLancey 1984a, 1985a, 1990) I have adduced evidence that the in model of agentivity which has the most general morphosyntactic relevance Agent can be identified with the ultimate identifiable cause (cp. Langacker 1986). This is what distinguishes Agents from Instruments. Compare:

1) A bomb damaged several pieces in the Renaissance Collection.

2) ??? A hammer damaged several pieces of sculpture.

Both examples have inanimate subjects, which according to received case theory means that *A bomb* and *A hammer* cannot be semantic Agents. This should entail that both will have the same morphosyntactic behavior with respect to constructions to which agentivity is relevant--such as the subject slot of a transitive predicate such as *damage*. But this is not the case. While (1) is an unexceptionable example, of a sort often adduced to show that English allows Instruments to be transitive subjects, (2) is decidedly peculiar, and could be said only in rather marked circumstances.

I have argued that the Instrument as subject interpretation of such examples is incorrect, and that in fact eligibility for transitive subject status normally requires some degree of agentivity (DeLancey 1984a; cp. Schlesinger 1989). The acceptability of (1) is due not to *A bomb* being an Instrument and thus eligible for subject status--an explanation which leaves the oddity of (2) unexplained--but rather to the fact that *A bomb* is in fact an Agent, i.e. an ultimate cause, rather than an Instrument, i.e. a mediating cause. This is because the explosion of a bomb can be--indeed almost must be--imagined without any other Agent in the picture, while an event of damage done with a hammer cannot be so pictured. Thus, IN THIS CLAUSE, the bomb is presented as the ultimate cause. While we may infer the likelihood of an anterior cause in the form of a more orthodox Agent, the event can be pictured, and described, without including any such participant. An event involving a hammer cannot be so pictured, and will not be so presented. This is the reality underlying the common imprecise assumption that an inanimate

entity such as a hammer "must" be an Instrument and "cannot" be an Agent.

It has been often suggested that split intransitive marking reflects agentivity more directly than most grammatical systems, with subject-marked intransitive subjects identifiable as Agents (e.g. Fillmore 1968:53). Various phenomena connected with specific split intransitive systems have been adduced as problems for this approach. Some of these should be discussed as diachronic phenomena, not directly relevant here. For this discussion we can restrict our field of interest to productive fluid-split S systems, where the case marking is clearly sensitive to semantic distinctions related to agentivity. Let us consider one class of problem discussed by Rosen (1984): that of bodily-process predicates such as 'cough' and 'fart'. These are anomalous in having their subjects marked in some languages like transitive objects, suggesting that they are patients, and in others like subjects, suggesting that they are Agents. This is problematic on two grounds. First, assuming an objectivist view of semantics in which a given entity in a given event type either "is" or "is not" an Agent, we would expect all languages to agree on the characterization of all arguments of all event types. Secondly, this class of predicates doesn't fit the general a priori view of agentivity, in being typically non-volitional.

An adequate understanding of agentivity and its syntactic expression should then allow us to answer the following questions:

> What are the determinants of intransitive S case marking in these systems?
>
> Why is there cross-linguistic variation in the case marking governed by certain predicates?
>
> Why is this variation associated with these particular categories of predicate?

Lhasa Tibetan has a particularly transparent split intransitive system which provides evidence for answers to these questions. (The argument is developed at greater length in DeLancey 1985a, b, 1990.) The following examples show the pattern, typical of fluid split intransitive marking, in which volitionality is not relevant to case marking of transitive actors (ex. 3), but is criterial for case marking of arguments of intransitives (exx. 4-5):

3) nga-s dkaryol bcag-song
   I-ERG cup broke-PERF/NON-VOLITIONAL
   'I broke a cup (inadvertently).'

4) nga-s rtsig-pa-'i sgang-nas mchongs-pa yin
I-ERG wall-GEN off-ABL jump-PERF/VOLITIONAL
'I jumped off the wall (deliberately).'

5) nga(*-s) rtsig-pa-'i sgang-nas gzags-byung
I wall-GEN off-ABL fell-PERF/1st GOAL
'I fell off the wall (inadvertently).'

All three predicate a change of state in the referent of an argument of the verb. What sets the first two off from the third is that the ergative-marked argument is the direct cause of the event. And as I have already argued, this is the fundamental component of agentivity--agentive morphosyntax is always used to identify a primary causal factor of some kind. What is criterial here is that this causal factor be separable from the actual event. This is easy to see in the case of the transitive example; the Agent is clearly distinct from the change of state in the patient. But the same argument cannot be applied to a volitional intransitive. In the intransitive examples, volitionality is criterial. This is assimilable to the "separable cause" interpretation if we treat volitionality as representing a decision, or act of volition, on the part of the actor, which is then a causal event distinct from the extensional event referred to by the predicate. Schematically:

(DECISION-->) ACT -------> EVENT
(cup breaks)

DECISION ----------> EVENT
(actor off wall)

In the 'fall' case, in contrast, the event is represented in the clause as having no antecedent cause.

Then we can explain the cross-linguistic variation in the treatment of bodily process predicates in the following way. Consider a predicate such as 'sneeze', which in Lakhota, for example, takes a subject-form argument, but in Lhasa Tibetan takes an unmarked object-form argument. Such events are easily conceptualizable as external events, distinct from the individual in/from whom they occur. This is why in many languages many of these predicates tend to be cognate object verbs. Then there are two perspectives which one might take on an event of this kind. Viewed objectively, the sneeze can be seen as emanating from--i.e. caused by--the sneezer, in exactly the same way as an indubitably agentive event such as a shout. But from the point of view of the sneezer, the impulse to sneeze is a visitation from somewhere else, not originating in a decision--and thus the sneezer plays an Experiencer role. Lakhota encodes the first representation of the event, Lhasa the second.

Agentivity and person

Thus far I have been casting a wide net, following morphosyntactic evidence in extending the application of the notion of agentivity to situations where many linguists would be disinclined to invoke it. But there is cross-linguistic warrant as well for a more restricted, more traditional view of agentivity--which is, of course, precisely what we would expect of semantic categories with a prototype structure. There is cross-linguistic evidence for the relevance of the widely-claimed components of volitionality and animacy, although not so much nor so clear as is often assumed, and considerable and clear evidence also for the widely-assumed though not so often demonstrated relevance of transitivity (see e.g. DeLancey 1984a, 1987). I want to briefly discuss one other factor not often mentioned, that of person.

General cross-linguistic evidence for an interaction between person and agentivity is found in split ergative or inverse-type systems in which notionally transitive clauses with 3rd person Agent and 1st or 2nd person patient are morphosyntactically marked with stigmata of intransitivity--a phenomenon observable in some Salishan, Wakashan, Tanoan, and other languages (Jelinek and Demers 1983, Emanatian 1988, and see brief discussion in DeLancey 1987). Probably related is the phenomenon reported for Tsova-Tush (Batsbi), a split-intransitive language in which only 1st or 2nd person intransitive subjects can be marked as Agents (Desheriev 1953, Holisky 1987; cp. DeLancey 1981).

An important clue to the interpretation of data such as these is found in a system occurring in modern Tibetan and certain related languages (discussed at greater length in DeLancey 1984b, 1985c, 1990). In these languages verbal morphology reflects the volitionality attributed to the actor in the event, but only in statements with 1st person, and questions with 2nd person, actors (data from Lhasa Tibetan):

6) nga-s dkaryol bcag-pa yin
   I-ERG cup broke-PERF/VOLITIONAL
   'I broke the cup (deliberately).'

7) nga-s dkaryol bcag-song
   I-ERG cup broke-PERF/EVIDENTIAL
   'I broke the cup (inadvertently).'

8) kho-s dkaryol bcag-song / *-pa yin
   s/he-ERG cup broke-PERF/EVIDENTIAL / *VOLITIONAL
   'S/he broke the cup.' (volitionality cannot be indicated)

I cannot elaborate the argument here, but it can be shown that this is fundamentally an evidential phenomenon--volitionality can only be indicated for first person, because the speaker can have direct knowledge of volitionality only for herself.

I have already suggested a definition of agentivity as the first identifiable cause of the event. A volitional action represents the most elaborated possible version of a causal schema. That is, in the case of accidents, emotions, unexplained events, etc., the causal chain is open at one end; the causation of the event is not adequately explained. In a volitional action, a satisfactory primary cause is identifiable. I suggest that this is the basis of the elaborated agentive prototype in which volitionality figures.

The Tibetan data suggest the plausible hypothesis that agentivity, like many other semantic categories, is experientially based, in the sense of Lakoff and Johnson 1980. But the full agentive prototype can be experienced only subjectively; the Tibetan data show that volitionality can be evidentially asserted only of the speaker, and can only be inferred for other Agents. In this respect it is parallel to subjective emotional states, which in Japanese, for example, can similarly be evidentially predicated only of the speaker, and can be predicated of others only with inferential marking (Watanabe 1984). This evidence for the relevance of person to the Agent prototype is of particular interest in the light of acquisitional evidence that predication of agentivity of the speaker appears earlier than attribution of agentivity to others (Budwig 1989).

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BOOTSTRAPPING FROM AGENCY: EARLY NOTIONS OF AGENCY ACCORDING TO PINKER'S SEMANTIC BOOTSTRAPPING HYPOTHESIS

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ABSTRACT

A fundamental problem in language acquisition is how children learn the formal vocabulary of the adult grammar, given that instances of syntactic categories, grammatical relations, and other syntactic elements are not perceptually marked as such in the input. A proposed solution to this problem, developed at length by Pinker (1982, 1984, 1987, 1989), is known as the Semantic Bootstrapping Hypothesis: children infer the identity of syntactic entities such as 'subject' in the input on the basis of the presence of semantic entities such as 'agent'.

The Semantic Bootstrapping Hypothesis is a source of insight into, and constraints on, early notions of agency. In order for bootstrapping to work, children must be able to detect the presence of agents in parent-to-child speech/contexts. Since young children haven't mastered the nuances of verb meaning, parents must use words whose semantic representations correspond closely to the child's conceptual encoding of a situation; under this constraint, children should at least be able to detect the presence of prototypical agents (volitional humans acting directly on patients). A primitive notion of agency underlying this type of bootstrapping is developed in Pinker's (1989) theory of semantic representation. Furthermore, Pinker (1989) can account, without extension, for some of the major variations in agency found across languages (DeLancey, 1984); to the extent that these types of agency can be communicated clearly in parental speech to young children, they are associated with the correct syntactic elements. Finally, the Semantic Bootstrapping Hypothesis is supported by developmental evidence showing that children have syntactic categories and that children are sensitive to semantic information about agency that forms the basis of bootstrapping.

The topic of this paper is how the bootstrapping problem, and Steven Pinker's particular solution to it, constrains -- or allows us to make predictions about -- early notions of agency. The paper is divided into five sections: the bootstrapping problem; the semantic bootstrapping hypothesis; the notion of 'agent'; variations in agency and causation; and development.

I. THE BOOTSTRAPPING PROBLEM

The bootstrapping problem is very simple, but I think profound. The child learning language hears only sentences in context, but must somehow on this basis formulate a grammar for the adult language. Crucially, this grammar is couched in a formal vocabulary, including (among other abstract elements) syntactic categories such as 'noun' and 'verb' and grammatical relations such as 'subject' and 'direct object'. The problem is that instances of formal vocabulary are not perceptually marked as such in the input. Nothing in the input tells the child what is the 'subject'; there is no unique perceptible marker that is attached to subjects across languages. And if the child generalizes on the basis of what can be observed in the input -- by attending to serial position, for example -- the wrong rules will be learned. Dilemma: how are grammatical relations identified on the basis of a seemingly irrelevant input? Henceforth I'll be talking about grammatical relations, and especially subjects in English; however, the bootstrapping problem applies to all formal vocabulary, in all languages. (See Pinker, 1987, for an excellent summary of the problem.)

II. THE SEMANTIC BOOTSTRAPPING HYPOTHESIS

For a number of years, Pinker (1982, 1984, 1987, 1989) has been developing a solution to this problem known as the SEMANTIC BOOTSTRAPPING HYPOTHESIS (SBH): children infer the identity of syntactic entities such as 'subject' in the input on the basis of the presence of semantic entities such as 'agent'. Basically, the child has to be able to identify agents on the basis of context and content words in the input. Identifying agents does not itself raise the bootstrapping problem as long as certain assumptions are made. The following four assumptions hold in chronological order, if you will, in the process of bootstrapping. First, the presence of semantic elements need only be a SUFFICIENT (not necessary) condition for parental use of syntactic symbols in the input; all agents must be subjects, but not all subjects have to be agents (or else there would be no need to bootstrap). In support of this assumption, Pinker (1984) found, in an analysis of the Brown corpus, that agents were always expressed as subjects in parental speech. There were no full passives in the entire sample. For this reason, this assumption is not hard to swallow. A second assumption, one that really sheds light on early notions of agency, may be called COGNITIVE TRANSPARENCY: young children haven't mastered the nuances of word meaning, so adults must use words whose semantic representations correspond closely to the child's conceptual encoding of a situation. If there is a large gap between the conceptual structure for a situation and the semantic representation for the corresponding sentence in the input, young children will have no way to 'bridge' the gap. Situations involving PROTOTYPICAL AGENTS (human, volitional agents acting directly on patients) are presumably more transparent to young children than those involving non-prototypical agents. For example, the context of *John broke the vase* (especially if John acts intentionally) is likely to be more transparent to a two-year-old than the context of *John made the vase break*, *The wind broke the vase*, or *The vase was broken (by John)*. Therefore, prototypical agents are the most relevant to SBH. Third, if we can assume that the child has access to parental speech in cognitively-transparent contexts, the semantic representations of input sentences can be created from content words (learned independently of grammatical rules). Fourth, and finally, linking rules can be used by the child to infer (e.g.) that an agent specified in the semantic representation of an input sentence is the subject of a verb.

Although the focus of this paper is on the actual process of bootstrapping from agents, and on what that might tell us about early notions of agency, there are some important consequences of learning syntactic symbols via semantic bootstrapping (Pinker, 1984, 1987). These include the ability of the learner to engage in distributional learning, based on the correct categories, relations, and rules. For example, properties defined by learned rules/argument structures (e.g., *The cat* is a subject NP in *The cat scares the dog*) could be used to categorize abstract words (e.g., *The situation* is a subject NP in *The situation scares the dog*). Furthermore, the identification of syntactic categories and relations could provide constraints on the search for new rules. Thus, learning if the subject agrees with the verb in a particular language is much easier if the learner knows the identity of these elements; instead of making comparisons for every pair of elements in the input, on every potential feature, the search space has been reduced dramatically. Finally, the identification of syntactic categories and relations might allow the child to apply universal conditions automatically (e.g., to know, without additional learning from the input, that he or she can't extract a *wh*-phrase from the subject).[1]

III. THE NOTION OF 'AGENT'?

There are at least three 'levels' at which we can think about agency, with each lower level being more exclusive than the one above it:

- Every variation in agency that is communicable.
- Every variation in agency that is relevant to morphosyntax.
- Every variation in agency that is relevant to SBH.

We're only interested in the latter two levels; let's look at these one at a time. Pinker (1989) claims that every variation in agency that is relevant to morphosyntax is a discrete variation on a basic agent-patient relation. In particular, Pinker (1989) suggests that the force-dynamics framework of Talmy (1988) provides a way of understanding this basic relation. Force interactions involve the opposing forces of two entities, each conceived as a body with an intrinsic tendency towards rest or motion. Languages differentiate between two types of force-exerting entities, depending upon which one is being focused on: the focal force entity, called the AGONIST, and the force entity that opposes it, called the ANTAGONIST. On this account, an 'agent' corresponds to an 'antagonist' (underlined in the following examples); a 'patient' corresponds to an 'agonist'.

Now admittedly, this characterization of 'agent' is very abstract. However, Pinker is not using *agent* as a defined term, but rather as a primitive, and the intuition behind the primitive status of 'agent' is provided by Talmy's force dynamics work. Force dynamics provides a framework for understanding a variety of related notions in a systematic way, including: whether the antagonist is stronger than the agonist (*John made the lamp topple*) or weaker (*The lamp stayed on the table despite John's effort to make it topple*); if the antagonist is stronger, whether 'causing' is involved (*The pump made the water flow from the tank*) or 'letting' (*The plug's coming loose let the water flow from the tank*); if causing is involved, whether it is causation by onset (*The wind made the ball roll*) or within a steady state (*The wind kept the ball rolling*). Notice that in these examples the antagonist may be a human, an instrument, or a natural force. One of the appealing aspects of this system is that it provides an abstract characterization of agency and causation which has ramifications throughout the language despite differences in the type of antagonist. Of course, whether an antagonist is a human or a dog or an instrument or a force may have morphosyntactic consequences in some languages -- so we'll have to mark such distinctions in some fashion (a topic we turn to below).

Concerning the narrowest conception of agency, the type of antagonist that is most relevant to SBH is the prototypical agent: human antagonists whose intrinsic force tendency is volitional. The reason for this, as noted as above, is that the role of a prototypical agent in an action is usually cognitively transparent. A related issue is WHERE prototypical agency applies. According to Pinker (1989), prototypical agency is specified in the semantic representation of a verb. For example, John is a prototypical agent in *John toppled the lamp* because the semantic representation of the causative verb *topple* specifies that a (usually) human agent acts directly on a patient causing it to move down in a toppling manner. (It's worth mentioning that linguists such as Halliday (1968) and Cruse (1973) share this view that agency is relational is character, holding between a verb and a noun.) Formally (see Pinker, 1989), *agent* is a mnemonic for the first argument of a dyadic primitive predicate ACT in the lexical semantic representation of a verb. A prototypical agent has the default property of being human.

In remainder of this paper, I'll discuss how SBH applies to non-prototypical agents, if at all, and try to summarize the developmental issues and evidence that bear on SBH.

IV. VARIATIONS IN AGENCY AND CAUSATION: CONTROL, DIRECTNESS, AND PERSPECTIVE.

The theory of semantic representation presented in Pinker (1989) can account, without significant extension, for some of the major types of agency represented in the world's languages, and furthermore (via the accompanying linking theory) for the general morphosyntactic ways in which those meanings are expressed. According to DeLancey (1984, 1985), certain subcategories of agency recur across languages, and differences between subcategories are often reflected morphosyntactically. One well-known variation in agency involves CONTROL -- the property attributed to the 'ultimate causer' or the 'head' of a causal chain (see DeLancey, 1984). For example, the argument corresponding to Bill has control in *Bill broke the window*, whereas the argument corresponding to the axe lacks control in *The axe broke the window*. Formally, the property of '+control' is approximated in Pinker (1989) by the property of '+human' attributed to the agent. (Control is usually attributed to human agents by virtue of their volitionality, but it is true that in some cases volitionality, humanness, and control can be separated.) A second variation, in causation rather than the nature of the agent per se, involves DIRECTNESS: the property attributed to causal chains that are not extended, that do not involve intermediates (see Shibatani, 1976; Haiman, 1983; DeLancey, 1984). For example, causation is direct in the case of *Bill broke the window*, but indirect in the case of *Bill made the window break by startling the carpenter, who was installing it*. In Pinker (1989), direct causation is a consequence of a dyadic ACT in the semantic representation of a verb; indirect causation follows from a monadic ACT. A third variation is PERSPECTIVE: whether an agent is foregrounded or backgrounded (see Foley & Van Valin, 1984, 1985). Thus, the argument corresponding to Bill is forgrounded in *Bill broke the window*, but backgrounded in *The window was broken by Bill*. Differences in perspective are represented in Pinker (1989) by the level of embedding, if any, of an ACT in semantic structure.

Since each of the variations in agency is independent of the others we can combine them to arrive at the following list of eight deviations from prototypical agency. Each combination of semantic values corresponds ('-->') to a particular syntactic form (e.g., active lexical causative) in which the agent argument is expressed (e.g., transitive subject):

1. +control, +direct, +foreground --> active (lexical causative), tr. subject
John shaved Bill. The storm broke the window.[2]

2. +control, +direct, -foreground --> passive, obl. object (*by*)
Bill was shaved by John. The window was broken by the storm.

3. +control, -direct, +foreground --> active (periphrastic causative), intr. subject
John made Bill shave.

4. +control, -direct, -foreground --> passive (of matrix verb), obl. object (*by*)
Bill was made to shave by John.

5. -control, +direct, +foreground --> active, tr. subject ('intermediary instrument')
The axe broke the window.[3]

6. -control, +direct, -foreground --> intransitive (unaccusative), obl. object (*from*)
*The window broke ?from an axe (*by an axe / *with an axe). John died from a disease.*[4]

7. -control, -direct, +foreground --> active (periphrastic causative), intr. subject
The ball caused the lamp to break, by knocking the table on which it was standing.

8. -control, -direct, -foreground --> obl. object (*with*) ('instrument')
John broke the window with an axe. The window was broken with an axe.

The main point of this list is to show that Pinker (1989) actually accounts for a wide range of correspondences between type of agent and type of morphosyntax. The reason that this is important is that we don't want, say, the sort of agency of a true instrument (8) to lead a child to conclude that what adults take to be an oblique object of *with* is for the child a subject (e.g., with a prepositional case marker). This potential error can be avoided if children are equipped to represent the semantic differences between instruments and prototypical agents, bootstrapping from the former to oblique objects of *with* and from the latter to subjects. Furthermore, a critical issue concerning these major deviations from prototypical agency is the extent to which they are even relevant to SBH: if major deviations from prototypical agency are cognitively transparent in parent-to-child speech/contexts, they are relevant to SBH; obviously, not every grammatically-relevant variation in agency is cognitively transparent to two-year-olds. Of these eight types of agency, only (1) and (8) -- at the extremes of this feature system -- are probably relevant to SBH. Some evidence for this claim is that the forms in (2)-(7) are themselves extremely rare in English parent-to-child speech. Of course, even if some of these forms were used there is no guarantee that the corresponding notions of agency would be cognitively transparent.

A final point about Pinker's (1989) view of agency is that the similarity between types of agency is due to a shared semantic primitive (ACT) in semantic structure; however, the 'prototype' of agency does not arise from the semantic level of representation per se. This approach leaves open the question of why a favored status is accorded to volitional humans acting directly on patients. It seems clear that some (cognitive) iconic and economic motivation underlies this prototype structure (see Haiman, 1983). Despite the complex issues of what constitutes a causal chain, where it really begins, how many links are involved, and so forth, we as speakers choose the economy of regarding agents as prototypically human because we ascribe free will to ourselves, and because we are naturally interested in ourselves; we are the beginnings (and ends) of many a causal chain. On the other hand, causation is prototypically direct under the influence of iconic motivation: linguistic distance mirrors conceptual distance.

V. DEVELOPMENT.

SBH assumes that the primitive semantic category of 'agent ' (first argument of ACT) exists throughout the relevant period of development. The category of 'subject' exists as well, but it must be identified for a particular language. Given these assumptions, SBH claims that children can induce the identity of the subject on the basis of its being linked to

the prototypical agent. This relationship can be made obvious to children as long as parents, in their speech to children, evoke cognitive representations in their children that correspond closely to the semantic representations of the spoken sentences. In addition, if major deviations from prototypical agency are cognitively transparent in parent-to-child speech/contexts, they are relevant to SBH and can be linked to the correct syntactic elements. If not, they won't play a role in bootstrapping; they will be learned in the same way that other aspects of verb meaning are acquired (see Pinker, 1989).

Two distinct types of developmental claims follow from SBH. First, children must have syntactic (as well as semantic) categories. This is a claim about the type of categories that children's knowledge of language is couched in. Support for this claim comes from work done by Virginia Valian (1986) and Paul Bloom (in press), among others. Bloom shows that young children avoid uttering sequences with an adjective followed by a proper name or a pronoun, even though they don't avoid uttering sequences with an adjective followed by a common noun, and they don't -- at a slightly older age -- avoid uttering adjectives in the predicate position, preceded by proper nouns, pronouns, or common nouns. For example, young children never say things like *big Fred* or *big he*, even though they do say things like *big dog*, *Fred (is) big*, and *he (is) big*. Bloom concludes that the only plausible explanation for this is that children have knowledge of abstract linguistic categories, such as that proper nouns and pronouns are NPs, and knowledge of word order through rules that order abstract linguistic categories, such as 'NP-->Adj N' (but not 'NP-->Adj NP').

A second developmental claim following from SBH is that children must use semantic information to identify the syntactic categories. This claim is more difficult to test than the first because it concerns children's actual learning (mapping from input to competence) rather than their competence at any stage. At the very least, it seems to be the case that children are sensitive to the relevant semantic information -- a prerequisite to bootstrapping from it. Evidence for this comes from the fact that young children talk about agents and causes (e.g., Bloom, Lightbown, & Hood, 1975; Braine, 1976; Budwig, 1989; Clark & Carpenter, 1989a, 1989b). In addition, some of the hypothesized correspondences used by young children in bootstrapping are presumably continuous with the correspondences between semantic arguments and grammatical functions that have been shown to be exploited by older children in learning verb argument structures (Gropen, Pinker, Hollander, & Goldberg, in press, in preparation).

A final developmental claim, which bears indirectly on SBH, is that a major source of children's syntactic errors will be incorrect or non-adult semantic representations for particular lexical items (as opposed to immature linking rules; see Pinker, 1989; Gropen et al., in press). For example, Budwig (1989) shows that young children choose different self reference forms to mark distinct perspectives on agency. This tells us something, at the very least, about the immature semantic representations of particular lexical items (i.e., pronouns and names), and is consistent with the view that children may have an overly narrow 'recognition procedure' for agent referents (see Huttenlocher, Smiley, and Charney, 1983). (Of course, an overly NARROW conception of 'agent' poses no difficulties for SBH.) A second example comes from Eve Clark and Kathie Carpenter (1989a,b), who show that young children (about two years of age) substitute *from* for *by* to mark agents. The authors argue that the children's substitutions arise because agents and causes are conceptualized as types of sources -- *from* is being used as if it MEANT (passive) *by*.

Why do these particular errors occur? It may be the case that a significant proportion of children's non-standard speech arises in cases where the assumption of cognitive transparency not merely fails, but MISDIRECTS (see Gropen et al., in press, for evidence from older children). Furthermore, instances of 'cognitive misdirection' plausibly point to the operation of cognitive universals -- such as the tendency of agents to be sources.

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NOTES

1. As should be clear from this last consequence of SBH, Pinker considers a grammatical relation to be universal by virtue of a set of universal properties or tendencies holding of such formal categories (e.g., see Keenan, 1976, on the universality of 'subject'). In fact, Pinker (1987) proposes that a set of models of formal-vocabulary acquisition, CONSTRAINT SATISFACTION, might help solve the bootstrapping problem by putting less reliance on bootstrapping from any one property of a grammatical relation. So, instead of the child just using the universal tendency for agents and causal forces to be subjects in active, declarative sentences, the child would take advantage of the full set of unmarked rules for subjects: for example, subjects tend to precede objects, NP positions in tensed clauses can be subjects, features of the subject can be encoded in verbal affixes, and so on. According to these models, the child uses incomplete representations of the input, plus the unmarked rules, in order to create the set of actual rules for his or her language. Constraint Satisfaction may be a process by which syntactically ergative languages are acquired, or incorrectly processed sentence/context pairs are recovered from.

2. Natural forces, computers, etc., may be assimilated to prototypical agents; see Cruse, 1973, for a similar view.

3. Restrictions on the acceptability of 'intermediary instruments' as transitive subjects (see Cruse, 1973) suggest that the '-control' feature must be present to distinguish them from case (1) (e.g., *John broke the window*); however, their grammaticality in English is made clear by their acceptability relative to transitive forms with 'enabling instruments' as subjects (e.g., **The spoon ate the pudding*; see Levin, 1985).

4. For a related form, see DeLancey (1984) on *k'é* constructions in Hare, an Athabaskan language.

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SEMANTIC ROLES AND GRAMMATICAL RELATIONS

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1. Introduction[1] Concepts like 'agent' and 'subject' figure prominently in discussions of child language and acquisition, and yet there are a number of important issues lurking in these terms. 'Agent' and 'patient', for example, are often used in two distinct senses: on some occasions, they are meant literally as the wilful instigator of an action and as the entity undergoing a change of state or condition, and on other occasions, they are used to denote the two primary arguments of a transitive predication, with 'agent' and 'patient' being cover terms of groups of distinct semantic roles which seem to function as 'logical subject' and 'logical object' of the verb. Grammatical relations, on the other hand, are often taken as unproblematically given. In this paper the nature of semantic roles and grammatical relations will be explored, as well as their interaction in language development. These issues will be investigated from the perspective of Role and Reference Grammar [RRG].[2]

2. Semantic roles Most syntactic theories assume some notion of semantic roles [SRs] but do not deal with basic questions which have remained unanswered since the original proposals of Fillmore and Gruber: what is the correct universal inventory of roles? what governs which role(s) a particular verb takes? Furthermore, there is the fundamental issue of the relation of SRs to GRs: is it universally predictable? The answers to the questions have important consequences for language acquisition, for the greater the degree of arbitrariness in the relationship between verbs and role(s) or between SRs and GRs, the more difficult the task facing the child is. The first step that RRG takes in answering these questions is to posit two types of SRs, corresponding roughly to the two senses of 'agent' and 'patient' mentioned in §1. They are termed 'thematic relations' and 'semantic macroroles'.

2.1 Thematic relations The question of the inventory of thematic relations [ThRs] in linguistic theory cannot be answered without a clarification of their function. In Fillmore's original theory, they had two functions: (1) they played a central role in the representation of the lexical meaning of verbs, e.g. '*open* [(A) (I) O]', and (2) they functioned in the statement of syntactic rules. Since most contemporary theories assume that syntax is autonomous, the second function is no longer relevant in them. ThRs serve only as a means of lexical representation in these theories, and it is this function that has led to disputes regarding the number of roles; if ThRs are representations of lexical meaning, then a large number will be required to express the great variety of verbal semantic contrasts.

RRG differs from other syntactic theories with respect to both of these points. It denies the autonomy of syntax, and therefore SRs play a direct role in syntax. On the other hand, ThRs have no direct role in the representation of lexical meaning. Rather, this is accomplished by means of the system of lexical decomposition put forth in Dowty 1979. Four classes of verbs are proposed, based on their inherent temporal properties or *Aktionsart*: states, activities, achievements, and accomplishments. Dowty provides syntactic and semantic tests for determining the class of a verb (see Dowty 1979:60). In the RRG system, states and activities are taken as primitive, and achievements and accomplishments are de-

[1] I would like to thank Nancy Budwig for organizing the session on 'agency' and inviting me to participate. This work was supported in part by a UC Davis Faculty Research Grant.

[2] See Van Valin 1990 for the most recent presentation of the theory, also Foley & Van Valin 1984; all of the aspects of RRG discussed in this paper are explicated in detail in these references.

rived from the basic types by means of a limited set of operators and connectives. Examples of the decomposition are given in 1: (a) is a state, (b) an achievement, (c) an accomplishment, and (d) an activity.

(1) a. The lamp is broken.	**broken′** (the lamp)
b. The lamp broke.	BECOME **broken′** (the lamp)
c. Bill broke the lamp.	[**do′** (Bill)] CAUSE [BECOME **broken′** (the lamp)]
d. The lamp is shaking.	**shake′** (the lamp)

These representations are significant because first, they represent a fundamentally different approach to lexical representation from lists of ThRs, and second, instead of the semantic representation of a verb being based on ThRs, ThRs are derived from the decompositions. Following Jackendoff 1976, ThRs are defined in terms of argument positions in lexical representations, e.g. 'patient' is the single argument of a state predicate (*the lamp* in 1a,b,c). Thus, in a theory in which the primary role of ThRs is in the syntax and not in the lexicon, only a small number of distinct ThRs need be posited. Moreover, because there are syntactic and semantic tests (which make no reference to ThRs) which determine the *Aktionsart* class of a verb and because the ThRs of a verb are function of its lexical representation, which is a function of its class, *the assignment of ThRs to verbs in RRG is independently motivated.*

The notion of 'agent' is generally considered one of the most important ThRs, but it is not in fact clear that it is of the same nature as the other ThRs. If ThRs are a lexical property of verbs, then they should be invariable in the different contexts in which a verb (with a specific *Aktionsart*) is used. But this is not the case, as the examples in 2 show.

(2) a. John (accidentally) killed his neighbor.
b. John (*accidentally) murdered his neighbor.

It is often assumed that both *kill* and *murder* take an agent argument, but if this is the case, then they both should not cooccur with an adverb like *accidentally* which contradicts the meaning of intended action which is a central component of agency. This prediction is correct only with *murder*; *kill* is compatible with a non-intentional, hence non-agentive, interpretation of its subject. This suggests strongly that the subject of *kill*, unlike that of *murder*, is not an agent but rather is what in RRG is called an EFFECTOR, the instigating, causing, effecting participant in a situation (*Bill* in 1c); this ThR is neutral with respect to intent and control. However, given that *John killed his neighbor* can be interpreted with *John* acting volitionally and intentionally, where does this interpretation of the subject as an agent come from, if not from the lexical semantic properties of the verb? It has long been argued that one of the ways to differentiate entailments which are inherent semantic properties of lexical items from pragmatic entailments is through the defeasibility test: if the meaning is defeasible or cancellable, then it is not an inherent semantic property but a pragmatic implication. The defeasibility of of the agentive interpretation of the subject in 2a indicates that it does not follow from the lexical meaning of *kill*, whereas the fact that it cannot be cancelled with *murder* signals that it is an inherent part of the verb's meaning. Holisky 1987 argues that for most activity and accomplishment verbs, the interpretation of their subject as agentive is a pragmatic implicature, based on the principle that human effectors are normally interpreted as agents, unless there is some explicit element (like *accidentally* in 2) that blocks the implicature. Thus 'agent' is not really a distinct ThR like effector, experiencer, theme, or patient; rather, it is an additional interpretation which is added to one of the basic ThRs. The subject of *murder* in 2b is an effector which obligatorily receives an agentive reading, while the subject of *kill* in 2a is an effector which optionally

gets this interpretation. Similarly, the subject of *see* is an experiencer, while that of *look at* is an agentive experiencer.

2.2 Semantic macroroles It was noted in §1 that 'agent' and 'patient' are often used to refer broadly to the two primary arguments in a transitive predication, the terms being applied to the arguments of both *kill* and *see* in this sense, even though the ThRs of these verbs are not the same. RRG captures this uses of these terms by positing a second type of SR, semantic macroroles [MRs]. There are only two MRs, actor and undergoer, and each of them subsumes a number of distinct ThRs. This is illustrated in 3 and 4.

(3) a. *Fred*$_{\text{ACTOR}}$ broke the clock$_{\text{UNDERGOER}}$. (Agent)
b. *The bomb*$_{\text{ACTOR}}$ shattered the windows$_{\text{UNDERGOER}}$. (Effector)
c. *Mary*$_{\text{ACTOR}}$ received a court summons$_{\text{UNDERGOER}}$. (Locative-Recipient)
d. *The farm animals*$_{\text{ACTOR}}$ sensed the coming storm$_{\text{UNDERGOER}}$. (Experiencer)
e. *John*$_{\text{ACTOR}}$ owns several Porsches$_{\text{UNDERGOER}}$. (Locative)

(4) a. Max$_{\text{ACTOR}}$ tossed *the keys*$_{\text{UNDERGOER}}$ to the policeman. (Theme)
b. The tidal wave$_{\text{ACTOR}}$ destroyed *the village*$_{\text{UNDERGOER}}$. (Patient)
c. The rock$_{\text{ACTOR}}$ hit *the door*$_{\text{UNDERGOER}}$. (Locative)
d. The thief$_{\text{ACTOR}}$ robbed *Larry*$_{\text{UNDERGOER}}$ of $25.00. (Locative-Source)
e. Bill$_{\text{ACTOR}}$ presented *Mary*$_{\text{UNDERGOER}}$ with a ring. (Locative-Recipient)

Each of the actors in 3 bears a different ThR, and yet they are all treated alike as the 'logical subject' of the sentence. A similar situation obtains in 4 with respect to undergoer; a range of distinct ThRs is treated alike as the 'logical object'. The prototypical actor is an agentive effector (the traditional 'agent'), and the prototypical undergoer is a patient. The relation between ThRs and MRs is expressed in the Actor-Undergoer Hierarchy in Figure 1. The ThRs in Table 1 can be ranked as more 'agent-like' and more 'patient-like' on a continuum, and in any clause, the argument bearing the ThR closest to the agent end of the continuum will be actor, while the one bearing the ThR closest to the patient end will be undergoer. Thus with *break* in 1c, the effector is actor and the patient undergoer, while with a verb like *see*, its experiencer will be actor and its theme undergoer.

```
ACTOR                                                    UNDERGOER
---------------------------------------------->
                                  <-------------------------------------------------
Agent   Effector   Experiencer   Locative   Theme   Patient
['----->' = increasing markedness of realization of thematic relation as macrorole]
```

Figure 1

Macroroles play a central role in syntax in a monostratal theory like RRG. This becomes particularly clear in passive constructions. The simplest statement of passive in English is to say that the undergoer appears as subject, while the actor occurs as an oblique. The same groupings of ThRs illustrated in 3 and 4 function analogously in passives, as 5 illustrates. MRs are the interface between ThRs and GRs and are not equivalent to either. This can also be seen in 6.

(5) a. The clock$_{\text{UNDERGOER}}$ was broken by *Fred*$_{\text{ACTOR}}$.
b. The windows$_{\text{UNDERGOER}}$ were shattered by the *bomb*$_{\text{ACTOR}}$.
c. The coming storm$_{\text{UNDERGOER}}$ was sensed by the *farm animals*$_{\text{ACTOR}}$.
d. *The keys*$_{\text{UNDERGOER}}$ were tossed to the policeman by Max$_{\text{ACTOR}}$.
e. *The village*$_{\text{UNDERGOER}}$ was destroyed by the tidal wave$_{\text{ACTOR}}$.

f. *The door*$_{\text{UNDERGOER}}$ was hit by the rock$_{\text{ACTOR}}$.

(6) a. The girl [SUBJ, ACTOR] ran down the stairs.
b. The girl [SUBJ, UNDERGOER] got sick.

3. Grammatical relations What are GRs? How can a linguist determine whether the relations between a verb and its arguments in a language are syntactic rather than semantic? This is a question of major importance for the study of child language, for there has been considerable controversy over the issue of the nature of verb-argument relations in early child language.

A GR is defined by a restricted neutralization of SRs for syntactic purposes. As an example, let us consider whether the restrictions on which argument can appear as the subject[3] of *seem* in a raising construction in English are best described in terms of semantic or syntactic relations.

(7) a. Jean seems to be jogging in the park.
b. Jean seems to be sick.
c. Jean seems to be watching a movie.
d. *Jean$_i$ seems the police to have arrested ___$_i$.
e. Jean seems to have been arrested by the police.

In 7 an argument of the dependent clause appears in the matrix clause. There are restrictions on which argument can so appear, as the ungrammaticality of 7d shows, but the crucial question is whether the restriction is to be stated in syntactic or semantic terms. The raised argument is the actor of an intransitive verb in 7a and the actor of a transitive verb in 7c, and it is the undergoer of an intransitive verb in 7b and the undergoer of a transitive verb in 7e. In 7d the raised argument has the same MR as in the grammatical 7e example; this is crucial evidence that the restriction cannot be stated in semantic terms. There is thus a restricted neutralization of SRs with respect to which argument of the dependent clause functions as the raised NP in 7, and this neutralization defines a GR, in this case the traditional subject in English. It is significant that the contrast between actor and undergoer is neutralized with both intransitive verbs (7a,b) and transitive verbs (7c,e).

A language has GRs to the extent that it has restricted neutralizations of SRs for syntactic purposes, as exemplified in 7. It has generally been assumed that GRs are a universal feature of human language and that they are basically the same in all languages. Serious doubts, however, can be raised with respect to the universality of GRs. First, there is at least one language, Acehnese (Austronesian, Sumatra), in which there are no restricted neutralizations of SRs in the syntax and therefore no GRs. Durie 1985, 1987 has argued that the only verb-argument relations relevant to the description of Acehnese syntax are actor, undergoer, and 'argument of the verb', none of which are GRs. Second, languages vary with respect to the kind of restricted neutralizations that they have. In English the actor-undergoer contrast is neutralized with both intransitive and transitive verbs, but in many languages this contrast is neutralized only with intransitive verbs, never with transitive verbs. In such a language, the single argument of an intransitive verb can function as subject, regardless of whether it is actor or undergoer, but with a transitive verb only the actor may be subject. In a construction like 7 in such a language, both 7d and 7e would be ungrammatical. Examples of languages of this type include Lakhota (Siouan), Warlpiri (Australian Aboriginal), Zapotec (Oto-Manguean), and Enga (Papua-New Guinea). In languages like these, the restricted neutralization defining the subject GR differs significantly

[3] I am using the traditional terms for GRs in this discussion, despite the fact that RRG does not in fact employ them; this is to keep the amount of unfamiliar terminology to a minimum. See references in fn. 2.

from the one in languages like English, Dyribal, Malagasy and Italian. This is summarized in Table 2.

Cross-Linguistic Variation in Restricted Neutralization of Semantic Roles

	Intransitive Vs	Transitive Vs	Grammatical Relations
Acehnese	NO	NO	NO
Zapotec/Warlpiri	YES	NO	YES
English/Dyirbal	YES	YES	YES

Table 2

It should be noted further that there may be different restricted neutralizations in different constructions within a single language; this is the much discussed 'split-subject' phenomena found in a variety of languages (see Van Valin 1981). Thus, not only are GRs not universal, they are not constituted in the same way in all of the languages that have them.

This variation is in principle independent of two other major variables of GR systems. The first is the status of a language as ergative or accusative; English and Zapotec are thoroughly accusative, and Warlpiri and Dyirbal exhibit morphological ergativity. Languages may realize both options, as in split-ergative languages. The second is the extent to which discourse-pragmatic relations like topic are grammaticalized in GRs; that is, in some languages the subject is a clause-internal topic, and discourse-pragmatic factors play a crucial role in the selection of the argument to function as subject. In other languages, however, discourse-pragmatic factors have no effect on the selection of the subject argument, which is determined largely by lexical semantic factors. English, Dyirbal and Malagasy are examples of the first type of language, while Zapotec, Warlpiri and Swahili are examples of the second type. This second variable does correlate to a large extent with the issue of the type of restricted neutralization(s) found in a language. Most of the English/Dyirbal-type languages in Table 2 have subjects which are grammaticalized topics, but not all; Swahili is a significant exception. None of the Zapotec/ Warlpiri type have subjects which are grammaticalized topics. The reason for this is that discourse-pragmatic factors like topicality can affect subject selection only if there is more than one argument of the verb in the clause; if the verb has only one argument, then there is no choice as to which argument will be subject. Hence only with transitive verbs can there be a choice, and in order for there to be a choice, there must be a neutralization of the actor-undergoer opposition. This is what differentiates the Zapotec/Warlpiri type from the English/Dyirbal type: in the latter, either argument of a transitive verb can function as subject, whereas in the former only the actor may be subject. Since there is no choice in these languages, discourse-pragmatic considerations cannot affect subject selection. There are languages (e.g. Swahili) in which this neutralization exists but in which discourse-pragmatic factors do not influence subject selection (see Foley & Van Valin 1984). The contrast between the two types of language is captured in the two summaries of the RRG linking scheme in Figure 2.

PRAGMATIC FUNCTIONS	GRAMMATICAL RELATIONS
↕	↕
(GRAMMATICAL RELATIONS)	PRAGMATIC FUNCTIONS
↕	↕
MACROROLES	MACROROLES
↕	↕
THEMATIC RELATIONS	THEMATIC RELATIONS
Acehnese & Zapotec/Warlpiri-type languages	English/Dyirbal-type languages

Figure 2

Pragmatic functions like topic play a role in determining GRs in English and Dyirbal, but

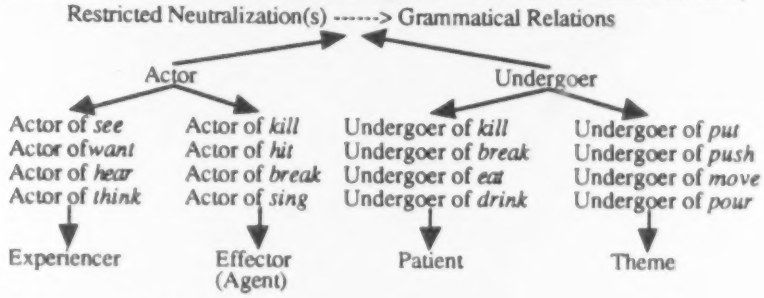
not in Zapotec and Warlpiri. Acehnese lacks GRs, and it can be included by making GRs optional in the first diagram. The means for signalling the discourse topicality of NPs is completely independent of the marking of SRs in this language; they are distinct subsystems in the grammar.

There are thus three major factors determining the GRs in a language: (1) the nature of the restricted neutralizations and how consistent they are in different constructions, (2) the pattern of association of the single argument of intransitive verbs with one of the arguments of a transitive verb, and how consistent this is across NP categories, tense-aspect series, etc., and (3) the extent to which discourse-pragmatic factors affect subject selection. GRs cannot be taken as unproblematically given.

4. Implications for acquisition The RRG theory of SRs and GRs has a number of implications for language acquisition and the analysis of child language. First, it makes possible alternative developmental sequences for the acquisition of GRs, as in Figure 3.

Potential Developmental Sequences for Semantic Roles and Grammatical Relations

(1) Thematic Relations ---- Semantic Bootstrapping---> Grammatical Relations
(2) Thematic Relations ---- Semantic Extension/Assimilation---> Grammatical Relations
(3) a. Macroroles -----> Grammatical Relations (via restricted neutralizations)
Macroroles -----> Thematic Relations (via generalization across classes of verbs)



b. Modified version of (2) above
Thematic Relations -----> Macroroles
Macroroles -----> Grammatical Relations (via restricted neutralizations)

Figure 3

The first two sequences assume that ThRs are linked directly to GRs. Sequence (1) is associated with Pinker 1984 and assumes GRs to be a part of the child's innate endowment; this assumption is dubious, for the reasons discussed in §3, and this calls the bootstrapping scheme into question. Sequence (2) is proposed by Schlesinger (e.g. 1988), and while it does not posit an innate set of GRs, it does not seriously address the problems raised by the diversity of GR systems in human languages; in particular, there are numerous languages in which subject cannot be not generalized from agent.

The contrast between ThRs and MRs affords a new possibility which is presented in sequence (3a): the child's entry into the system is at the level of MRs. This is the recognition of the basic contrast between doer of the action and non-doer of the action, which, in the prototypical case, is affected by the action. Braine & Hardy 1982 argue that there is no evidence for a GR 'subject' in early child language and that the relevant relation is not the specific ThR 'agent' but rather a more general SR of 'actor', which is very close to the MR actor. Specific ThRs follow from the awareness that the actor with a verb like *kill* or *hit* is different from that of *see* or *want* and that the undergoer with a verb like *kill* is differ-

ent from that with *push* or *put*. In the vast majority of human languages there is a level of GRs distinct from the SRs, and thus the child must also learn that these semantic distinctions can be neutralized in various ways (see Table 2), with the resulting relations being grammatical rather than purely semantic. Of the three possibilities in Table 2, the Zapotec/Warlpiri system is by far the most common in human languages, and therefore it would be reasonable to hypothesize that it represents the initial phase of the development of GRs by children. This is a very semantically oriented system, with subject selection in every case being determined by lexical semantic properties of the verb. Children learning the few languages like Acehnese must learn that there is in fact no restricted neutralization with intransitive verbs, whereas children learning languages like English and Malagasy must learn that MRs are also neutralized with transitive verbs as well. There is considerable evidence in support of this view; it is well known that the subject of transitive verbs in English is always the actor in early child language and that it is only much later that syntactic passives (in which the neutralization of MRs with transitive verbs is realized in English) are mastered. Children learning languages like English and Italian thus start out with a Zapotec/Warlpiri-type system of GRs.[4] It should be noted that the distinction between ThRs and MRs does not necessarily entail that MRs be the starting point into the system; sequence (3b) represents a modified version of (2) in which ThRs are generalized to MRs via semantic assimilation, and then MRs are generalized to GRs. Only empirical research will reveal which of these possible sequences, or combination of sequences, yields the best account.

The considerations regarding GRs in §3 show that they cannot simply be taken as universal and innate; rather, given the variation in GRs across languages, they must be learned, and the child must sort out the relative contributions of SRs and discourse-pragmatic factors to the constitution of GRs in the language being learned. The range of mappings among grammatical forms, SRs, and discourse-pragmatic relations predicts variation both within languages and across languages in acquisition, and from an RRG perspective the crucial question is: how directly are the semantic and discourse-pragmatic functions of arguments coded in morphosyntax? Where there are clear-cut one-to-one mappings between form and function, these should be acquired earlier and with the least amount of trouble. Rispoli 1990 explores this issue with respect to grammatical phenomena in Turkish, Hebrew, Kaluli and Italian and shows this to be the case. With respect to the languages discussed here, Acehnese children should master the systems of SRs and discourse-pragmatic relations sooner and with fewer problems than English children, because the two systems are conflated in English but kept distinct and coded directly in Acehnese. Problems will arise for English children when, having learned that sentence-initial position normally codes both actor and higher topicality, they try to indicate the higher topicality of a non-actor. At this point they must master the restricted neutralization with transitive verbs and the grammaticalization of topicality in the English subject GR. For an Acehnese child no such problem will exist, because the actor-coding and topicality-coding devices are fully separate and independent. Similarly, children learning Zapotec and Lakhota would also not face this problem, since discourse-pragmatic relations are not part of the GR system; distinct mechanisms are used for signalling topicality. Sesotho children are presented with a

[4]This undermines the argument made in Hyams 1986 about the nature of GRs in child language. She shows that intransitive verbs in Italian agree with their single argument regardless of its ThR, and argues that this proves that "grammatical agreement is a strictly formal process which holds between what is traditionally referred to as 'subject' and 'verb'."(138) While it is true that agreement is not sensitive to SRs, as in Acehnese, her conclusion is false, if by 'subject' she means the same notion of subject as in adult Italian. The children at the stage she presents have only the Zapotec/Warlpiri system; that is, MRs are neutralized only with intransitive verbs, unlike adult Italian, in which there are restricted neutralizations with both transitive and intransitive verbs, just as in English. Thus the evidence that she cites shows only that Italian children do not have an Acehnese-like system, not that they have the same GR system as adult Italian speakers.

rather different situation, according to Demuth 1989, 1990. The direct form-function correlation presented to them is preverbal position and definiteness-high topicality, not preverbal position and actor, as in English, and moreover children are exposed to a high frequency of passive constructions very early on, due to this correlation. Because a preverbal NP must be presupposed and definite, the only way to form a WH-question when the question word is the actor of a transitive verb is to use a passive. Hence simple questions like 'Who ate this?' or 'Who hit you?' require the use of the passive in Sesotho. In English, in contrast, there is no construction in a simple clause which requires the use of a passive construction. Sesotho children are thus confronted with a direct form-function correlation and a high frequency of passive constructions related to this correlation, and therefore they should learn the discourse-pragmatic aspects of clause structure simultaneously with the role-coding system, thereby predicting early mastery of the voice system that permits different arguments to occur as subject in a clause. Demuth shows that this is in fact what occurs.

Thus, unraveling the acquisition of the relational aspects of grammar involves the recognition that semantic roles fall into two types, thematic relations and macroroles, and that grammatical relations are not simple universal primitives but rather are not universal and are not constituted in the same way in every language that has them.[5]

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